WIRED

UK EDITION

the DESIGN ISSUE

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GADI AMIT'S UNDERSKIN WEARABLES

FEATURING

OLAFUR Eliasson's CREATIVE MANIFESTO

+

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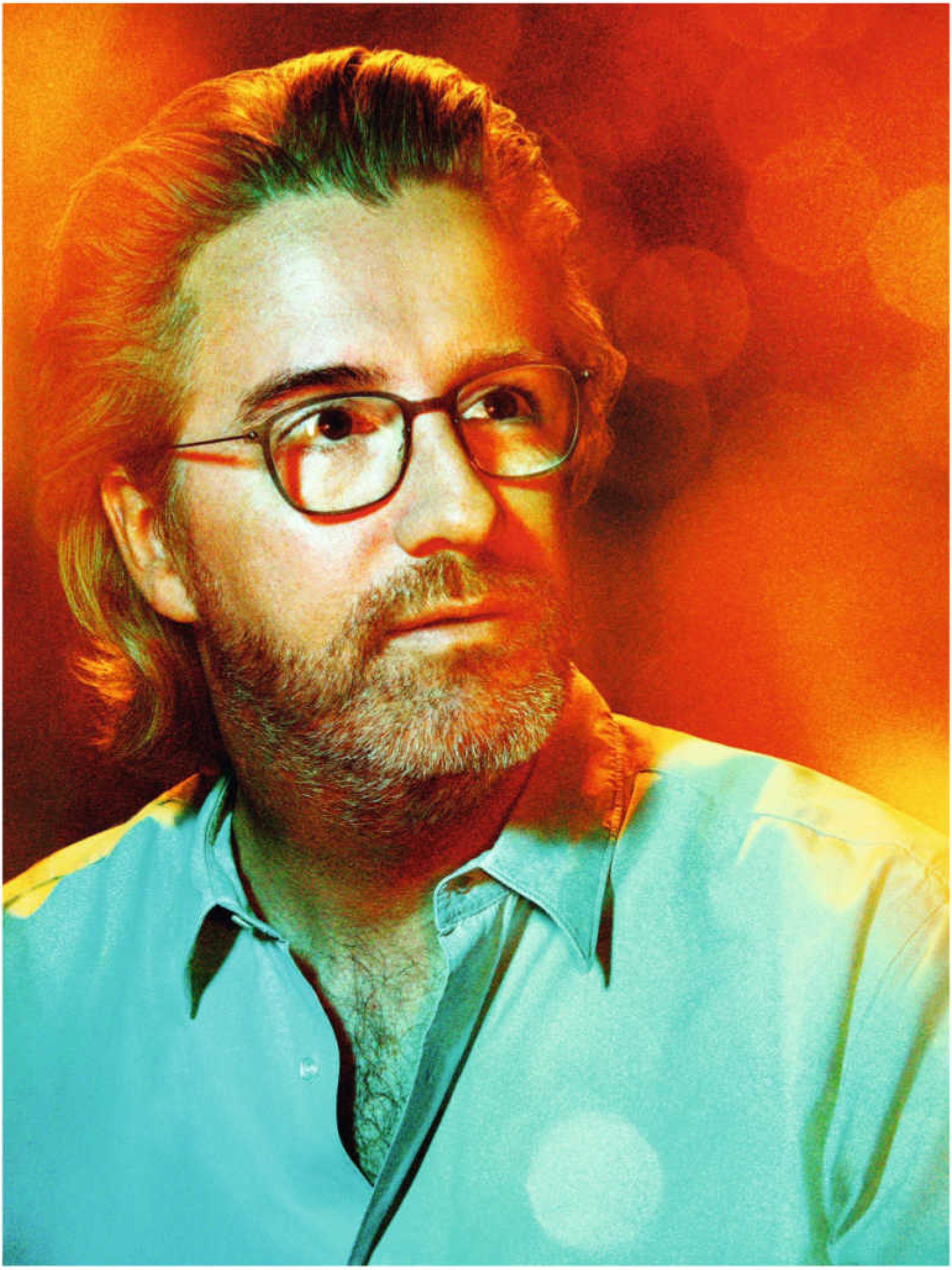

PHOTOGRAPHY (COVER AND THIS PAGE): PARI DUKOVIC. COVER LETTERING: ERIK MARINOVICH

Olafur Eliasson, photographed at his Berlin studio, July 2015

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'Art will change the world'

Artist, social entrepreneur, lamp designer, activist, breakdancer, hyper-collaborator: Olafur Eliasson is a new kind of polymath

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HENRIK KUBEL & SCOTT WILLIAMS

Kubel and Williams, founders of A2-Type, supply the guest fonts in this design issue. “A2-3D in particular mixes old and new tech – letterpress and 3D printing,” says Kubel. “It’s very WIRED.”

DAVID VINTINER

Photographer Vintiner captures the first wave of micro:bits – the free mini-computer from the BBC – as they hit UK schools. “I wanted to get across how curious the kids were about them,” he says. “The scheme will have its critics, but the BBC has always educated.”

ERIK MARINOVICH

San Francisco-based lettering artist Marinovich adds a hand-drawn flair to our cover this month. “I wanted to create lettering that emits the confident tone and spectacle found in Olafur Eliasson’s work,” he says. “I still love his NYC waterfalls.”

HANDCRAFTED TAKEOVER

You may notice WIRED’s illustrations look a little different this month – all in honour of our Design Special theme. WIRED creative director Andrew Diprose explains: “We wanted to switch up how we commissioned our illustrations and really celebrate the handmade. We had artists work in collage or supply un-retouched line work. We were thrilled with the results – cut marks, pencil outlines and all.”

PARI DUKOVIC SHOOTS OLAFUR ELIASSON

Dukovic captures our cover star, artist Olafur Eliasson: “Artists are my favourite subjects, and I loved his studio – sketches and plans on every surface. I used coloured gels to echo his work, to make something emotional: a dance of colour.”

RICHARD BENSON

Benson interviews creative powerhouse Olafur Eliasson for this month’s cover feature. “First and foremost, Eliasson is interested in people – his work is often a tool for affecting them,” says Benson. “His ‘try it and see what happens’ approach to art is really inspiring.”

NICK COMPTON

Compton visits Steelcase – the office furniture maker that is rethinking the workspace. “The pitch is you need the right space for each job, so we don’t fritter away our working time,” he says. “We’ll all have to learn to not be territorial about our desks.”

JONATHAN BELL

Bell travels to Sweden to go behind the scenes at IKEA – the furniture maker that conquered the world. “IKEA has evolved alongside society and its tastes,” he says. “People don’t even recognise it as Scandi-style now – it’s just good, contemporary design.”

PHOTOGRAPHY: TOMOKO SUWA; CHRIS FLOYD. ILLUSTRATION DETAIL: MARK LAZENBY

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OFF-PAGE

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MAGAZINE
WIRED 100/HOTTEST STARTUPS

What do we do about this lack of inspiring, influential women at the top, and how do people like me get there? I've easily managed to fill my 50 places with awesome people who happen to be women. Influential comes in all shapes, not just male. In fact, if you'd like some help with your homework, why not come along to my next networking event and meet some of the women reshaping the digital world. **Abigail Freeman, via email**

MAGAZINE
OLIVER SAMWER

"In 2014, the Samwer *brothers* were number two in the WIRED 100 list. This year, Marc and Alexander are not even listed. Did they upset the editor?" **Steve Fentiman, via email**

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TAKE A HIKE, SOCIETY

'I guess it learned a lot about humanity'

(Hitch-hiking robot that relied on human kindness found decapitated, wired.co.uk)." **Erin Fletcher, via Facebook**

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BIG-CITY BIAS

WIRED, oh you provincials: you focus only on capitals and miss the good stuff. Check out Exeter innovation centre, Exeter Science Park and Exeter Skypark. Or, alternatively, keep your heads in the sand! **Joe Baker, via email**

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FEAR OF A MECH PLANET

"Modern AI in machines is nowhere near the complexity of human consciousness, and will not be for a while more (Musk and Hawking warn of 'inevitable' killer robot arms race, wired.co.uk). People think that Watson, on the show *Jeopardy*, was a thinking machine, but in reality it had no awareness of itself nor its surroundings to suggest that it is intelligent beyond a self-operating Google lookup device. This fear of AI is just academics and billionaires spreading absurd paranoia and colluding for their own special interest." **Andrew Lohbihler, via wired.co.uk**

FEEDBACK
THE WIRED 100 IN THE HEADLINES

Goodnewsfinland.com:
"Finns show their influence on WIRED 100"
Medium.com/@edans:
"Not a Spaniard in sight in the 2015 WIRED 100"
Dinheirovivo.pt:
"WIRED discovers the 100 most influential Europeans – meet the Portuguese"

MAGAZINE
RE: LIVING BALL

"Melissa Sterry, through Bionic City, collaborated in the Leapfrog Project initiative, and not the Living Ball's design, construction and installation (Biomimicry Builder, 08.15). The Living Ball idea had already been developed by my architecture practice ALLL prior to the first collaborators' meeting in Chicago on June, 2014 in which Melissa shared her expertise. As chief collaboration architect at ALLL, I'm the main author who has moral rights to the Living Ball. Melissa's involvement was limited to delivering two lectures on Bionic City, as well as email correspondence with me." **Lira Luis, via email**

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FROM THE EDITOR

Welcome to the annual design-themed edition of WIRED – our opportunity to showcase some of the people, trends and businesses that are currently getting us excited. We've flown our writers and photographers tens of thousands of kilometres this month to get close to the designers whose impact we feel will be widespread – and in the case of IKEA, we travelled both to Shanghai and to Sweden to learn how tomorrow's kitchens and bedrooms take shape. When we get deep access at WIRED, we prefer to tell a thorough story – and besides, they still print a couple of hundred million annual catalogues, famously double the number of Bibles. How could a shiny magazine not celebrate such dedication?

Above: Little Sun Charge, Olafur Eliasson's solar-powered smartphone charger, launches early next year

Design matters more than ever today – from the user-experience expertise that determines which smartphone apps will thrive or die, to the data-driven enhancements of a retailer's physical store layout. As our creative director Andrew Diprose reflected to me when we were planning this issue, there's been a huge shift both in business and in the significance of design – "how design isn't so much perceived as making something aesthetically pleasing, but rooted in its form, function and how it affects people's lives", as he put it. That's why we've sprinkled innovators throughout our Start, Play and features sections, the latter with a profile of Steelcase, the Michigan company that's the world's largest maker of office furniture.

It's not always simple encapsulating an eclectic and diverse selection of stories with one individual cover star. In past years, we've put Thomas Heatherwick and Ron Arad on the front of the magazine – and both, through their hybrid forms of creative expression, were just right at that moment. Yet who represented today's hybrid nature of creative design – ranging as it does from artistic expression to entrepreneurial energy and product creation? Thankfully our rather brilliant deputy picture editor, Dalia Nassimi, nailed it in her suggestion of installation *wunderkind* Olafur Eliasson. The Danish/Icelandic artist may be best known in the UK for his Tate Modern *Weather Project* show, but he's consistently pushing boundaries, with his Little Sun solar-powered-light business, his work for New York's High Line park, his Fondation Louis Vuitton projects and so much more.

Eliasson also happens to have been a judge of the first WIRED/The Space Creative Fellowships – a project funded by The Space that will use £100,000 to help three digital artists produce new works. You can meet the winners this issue, as well as the 13 WIRED Innovation Fellows who will be speaking at our WIRED2015 event in London on October 15-16. They will be among around 50 speakers who will bring their stories to Tobacco Dock in east London for our fifth annual event. I do hope you will be able to join us – the event is designed to excite you.

David Rowan

David Rowan

PHOTOGRAPHY: DAVE LIDWELL

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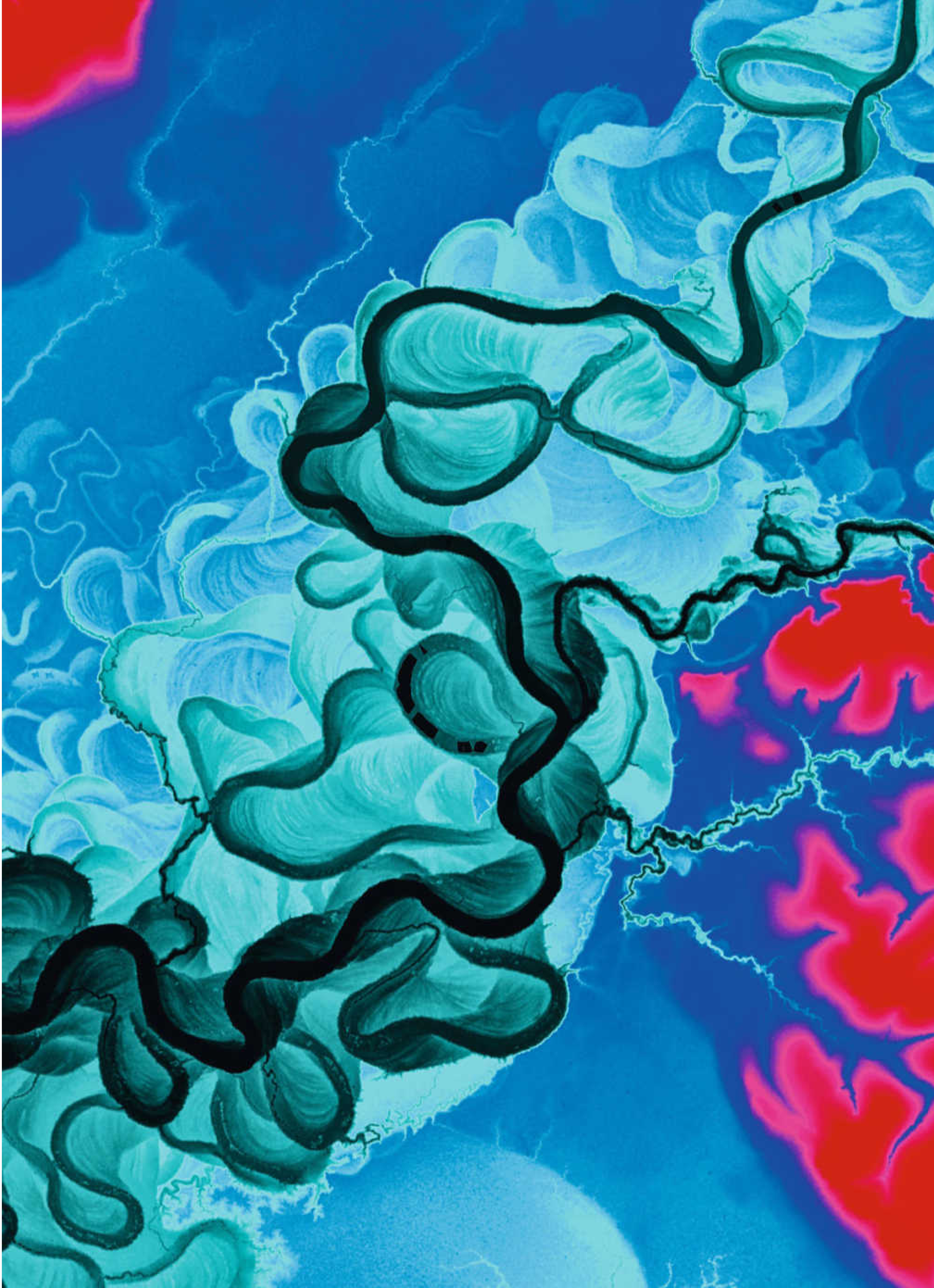

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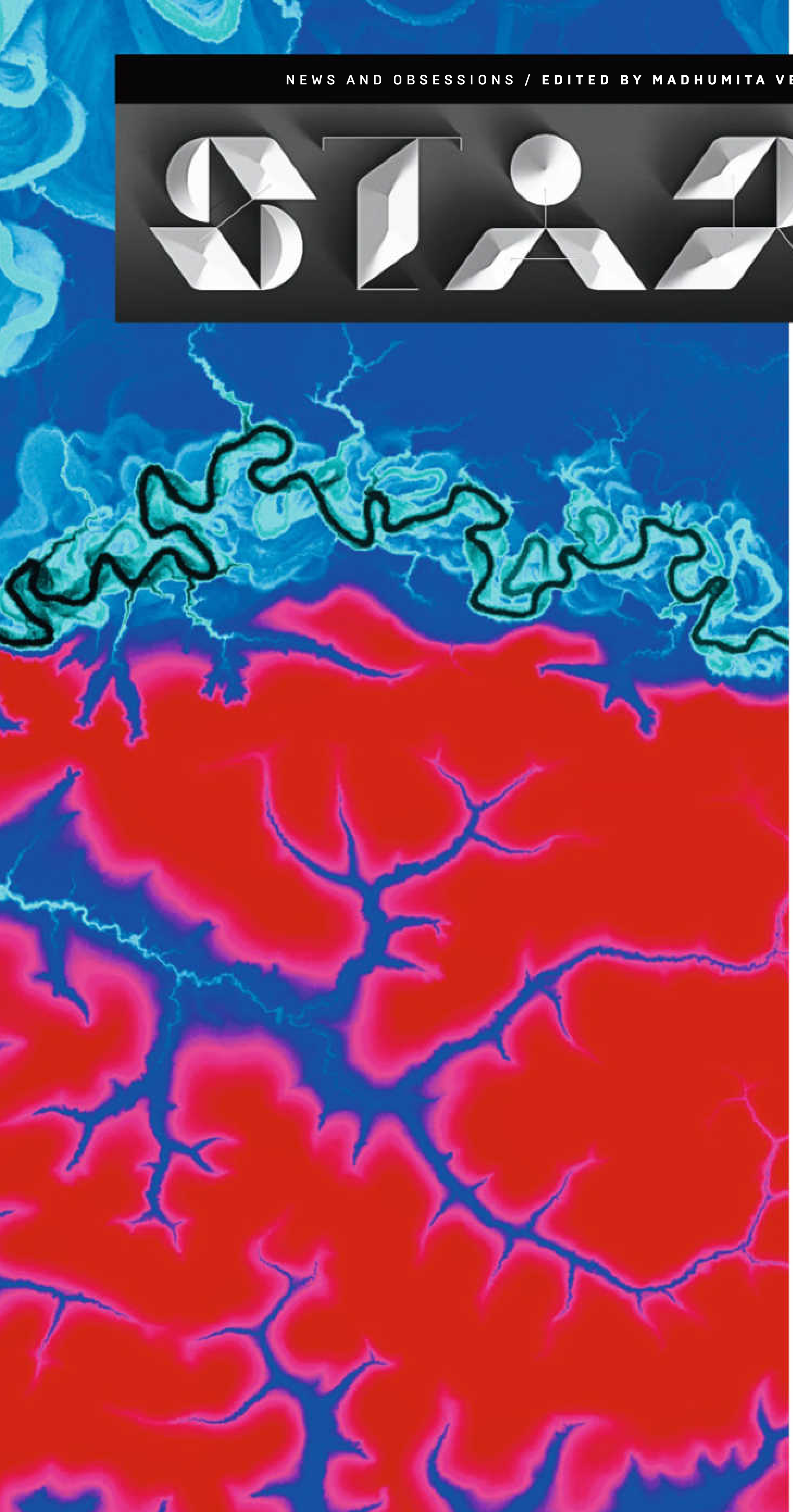

PSYCHEDELIC RIVERBEDS

This multicoloured laser image is the Tambopata River in Peru: the winding black line represents the waterway now; the surrounding squiggles are historical tracks left by ancient rivers – some 5,000 years old. The snapshot comes from the Carnegie Airborne Observatory (CAO), an aeroplane with infrared lasers. Developed by Earth scientists from Stanford University and the Carnegie Institute, the lasers create geological scans in 3D.

The system highlights changes in ground elevation (blues show low points just above the river; pinks and reds represent land a few metres higher) and so reveal the river's historical routes. "I can fire two lasers out of the plane at different angles, so we get maximum penetration of the forest canopy," says Greg Asner, CAO's principal investigator (see WIRED 03.12). The lasers travel downwards in a series of pulses – 500,000 per second – striking leaves, branches and, finally, soil. Their reflections build a 3D picture of the landscape which researchers can then peel back in layers.

CAO made this image while mapping deforestation in Peru. Even in the 3,000 hectares of protected land around the Tambopata River, illegal gold mines are encroaching on forest and poisoning wildlife. Next up for CAO: 3D-mapping the forests of Ecuador and Borneo. **Emma Bryce**
cao.carnegiescience.edu

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THIS WRISTBAND WON'T TRACK YOUR fitness, nor gauge your temperature, read your pulse or count your footsteps. Instead, it wants to change your mood with vibrations.

"It releases a pulse in a rhythm which acts just like music," says Jack Hooper, co-founder of London startup Team Turquoise, which makes the Doppel wristband. "Upping the pulse tempo will make you alert, while slowing it down will relax you. And you can use it in places where music may be distracting."

Launched on Kickstarter in June, the £70 Doppel had exceeded its goal of £100,000 as we published, and the team is working with Disney to test out the product.

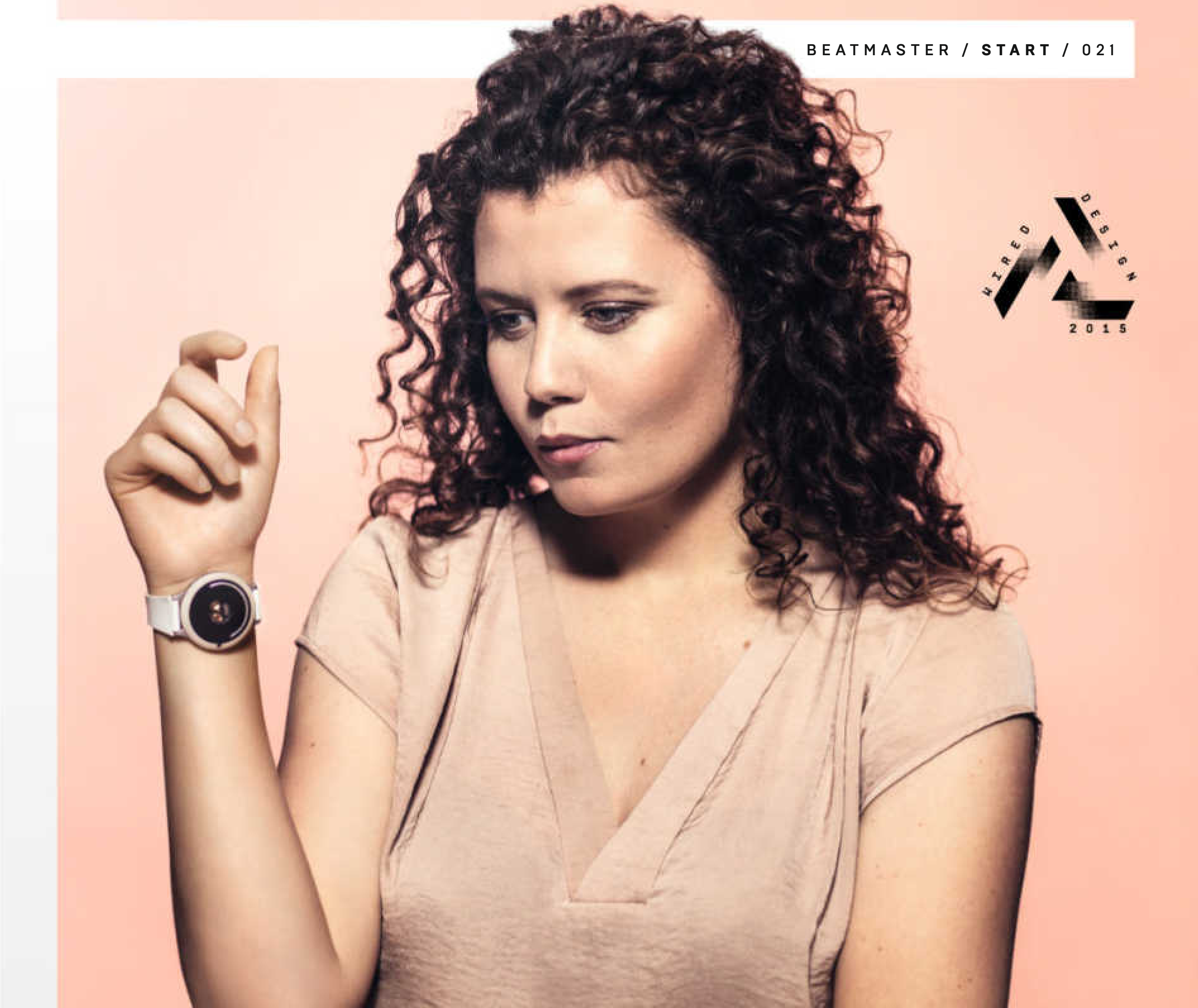
"We were interested in how the body reacts to stimuli, and how we could intervene in a useful way," says co-founder Nell Bennett (*below*), Doppel's designer. So they began to research "entrainment" – a process by which humans respond to external rhythms by auto-synchronising their heart rate with the beat. A well-documented example is the way the hearts of mother and infant sleeping together tend to thump in unison.

FEEL THE BEAT

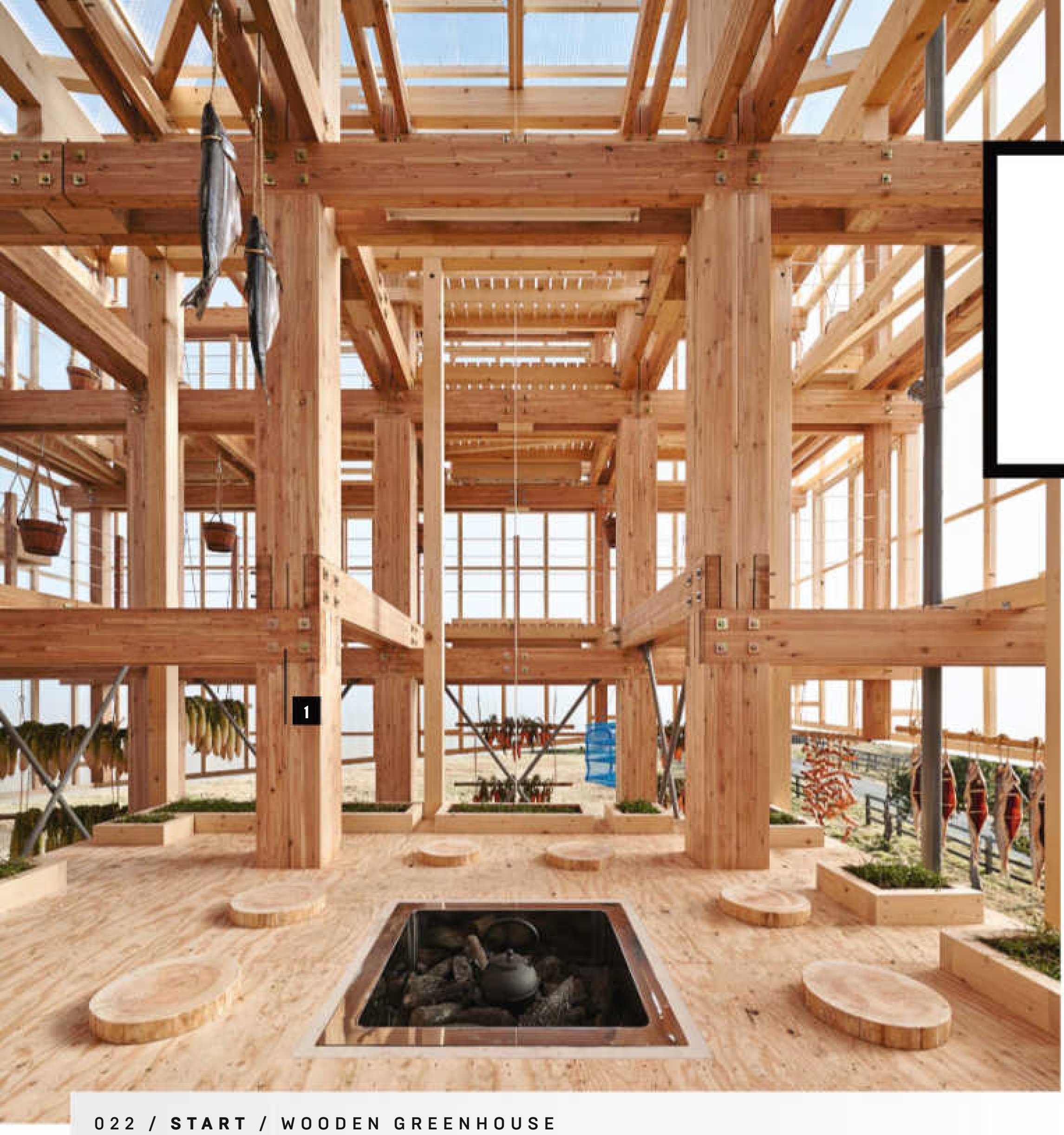
The Doppel has a companion app that initially takes your resting heart rate via your smartphone's camera. This lets the wristband create rhythms for stimulating and calming. Stroke the dial to slow the beat; press to speed up; or rotate it to adjust the intensity

The startup decided to use the beats to help people focus and relax. In February, they commissioned the Laboratory of Action and Body at Royal Holloway to test Doppel's effects. Forty people – half wearing Doppel on quick mode – had to carry out a repetitive task without losing concentration. "Those wearing Doppel maintained focus for much longer than the others," explains psychology professor Manos Tsakiris, who conducted the experiment.

The neural mechanism remains unclear, but Tsakiris thinks that Doppel's "heart-like stimulation" might trigger an entrainment effect. "Our heart rate modulates our cognitive performances and processes," he says, so a quick pulse could make us more reactive. Team Turquoise aims to ship its wristbands in April 2016. MV *tturquoise.com*



PHOTOGRAPHY: SAM BARKER



JAPAN'S HANGING GARDEN

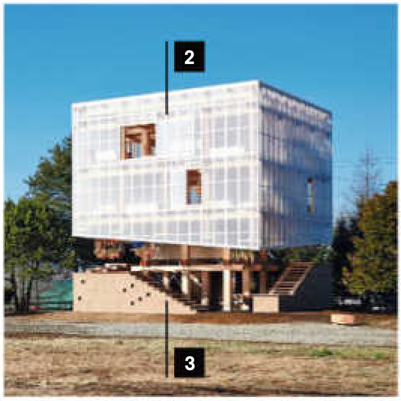
This self-sustaining vertical farm fuses Californian know-how with Hokkaido traditions

This 85m^2 public structure in Japan uses the light, air and water of its surroundings to grow local produce, from watermelons to adzuki beans. The project, a collaboration between graduate students from UC Berkeley and Japanese architecture firm Kengo Kuma, brings a slice of Californian style to Hokkaido. "Where the architectural approach comes from is not important if it can reduce the environmental cost," says team leader Hsiu Wei Chang.

The building – known as Nest We Grow – is built around nine composite columns, each made up of four 15cm x 15cm larch sections, connected by steel plates and pins. This mimics heavy timber construction techniques common in the US, but uses local materials. Increased light and heat towards the upper floors creates ideal growing conditions regardless of the season – so the third and fourth levels are filled with planter boxes. Other produce can be hung out to store and dry. Corrugated plastic walls trap the heat of the Sun in the cooler months, but can be opened for ventilation. Rainwater is captured by the funnel roof; a kitchen, log oven and composting area enables vertical farmers to harvest, cook, eat and recycle the food in the same space they grow it.

At the building's heart is a traditional Japanese tea area for socialising among the crops. Plants even grow from the tearoom floor, and hemp ropes will be installed along the outer frame. "We imagine beanstalks growing up the rope to form a green wall," Chang says. Looks like we've also outgrown the need for interior designers.

Sophia Epstein *kkaa.co.jp*



1. COMPOSITE WOOD COLUMNS
By using "moment" connections, the beams sit in niches in the columns, secured by steel pins. This locks the top and bottom flanges of the beam, making for a highly rigid structure.

2. SLIDING PLASTIC PANELS
The façade and roof are made of translucent corrugated plastic sheets that allow natural light in for the plants, and also hold in heat during winter. In the summer, panels in the walls and roof open up, to facilitate movement of air.

3. MULTI-USE GROUND FLOOR
The structure sits on a concrete, adobe-brick and packed-earth base, containing a multi-level facility. Within it are a food preparation area, a dining area, and access to composting bins.

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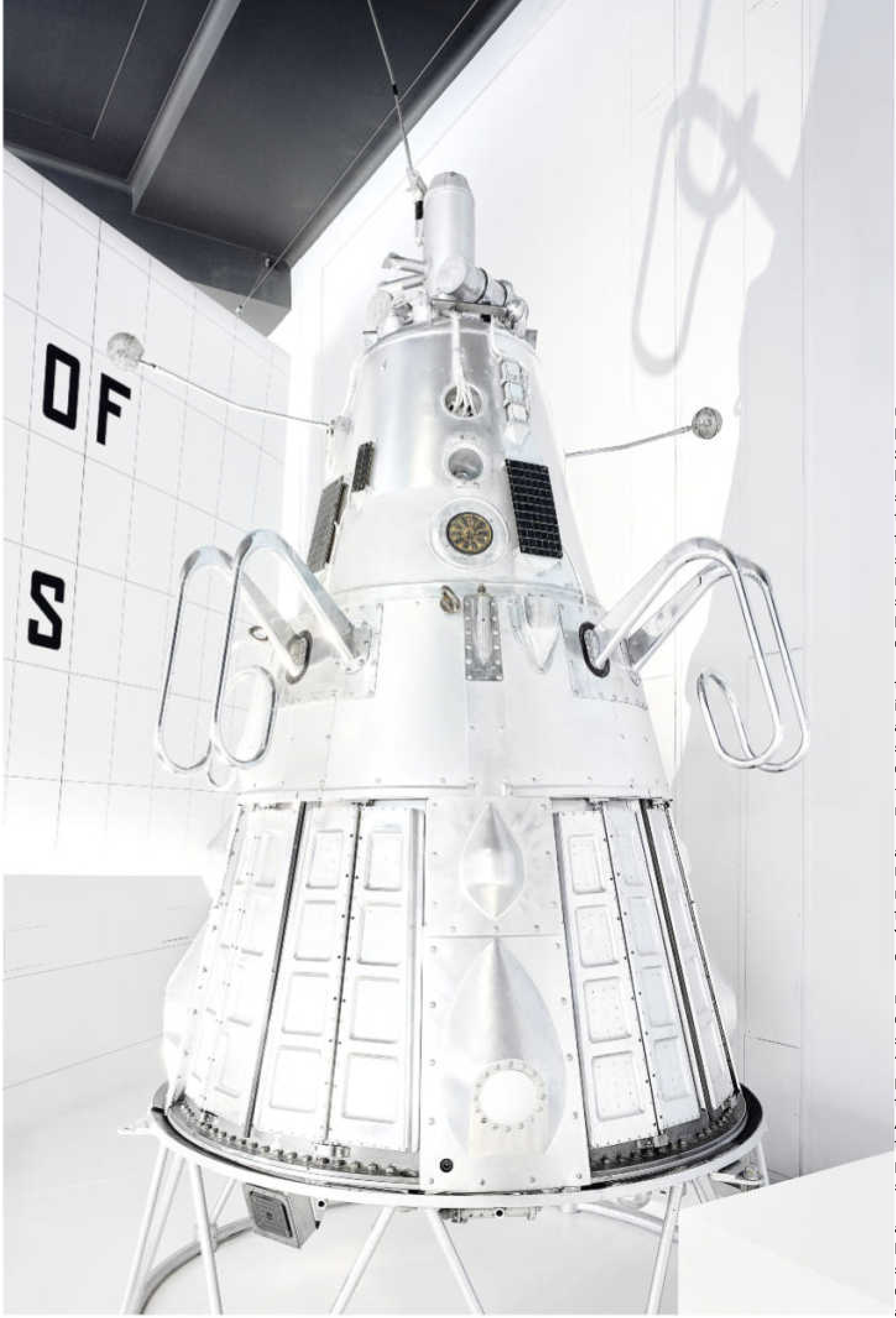


PHOTOGRAPHY: CHRISTOFFER RUDQUIST

▲ Daleks, born in 1963, may look like the *Sputnik 3*, but WIRED's official *Who* source denies a link. Yeah, right...

BAIKONUR, WE HAVE A PROBLEM

The rise and fall of the USSR's space project goes on display

SOVIET SPACECRAFT have landed in London's Science Museum for the largest exhibition of Russian space travel ever shown in the UK. "For many years we felt that Soviet and Russian space exploration was under-represented in the museum," says Doug Millard, deputy keeper of technologies and engineering at the museum.

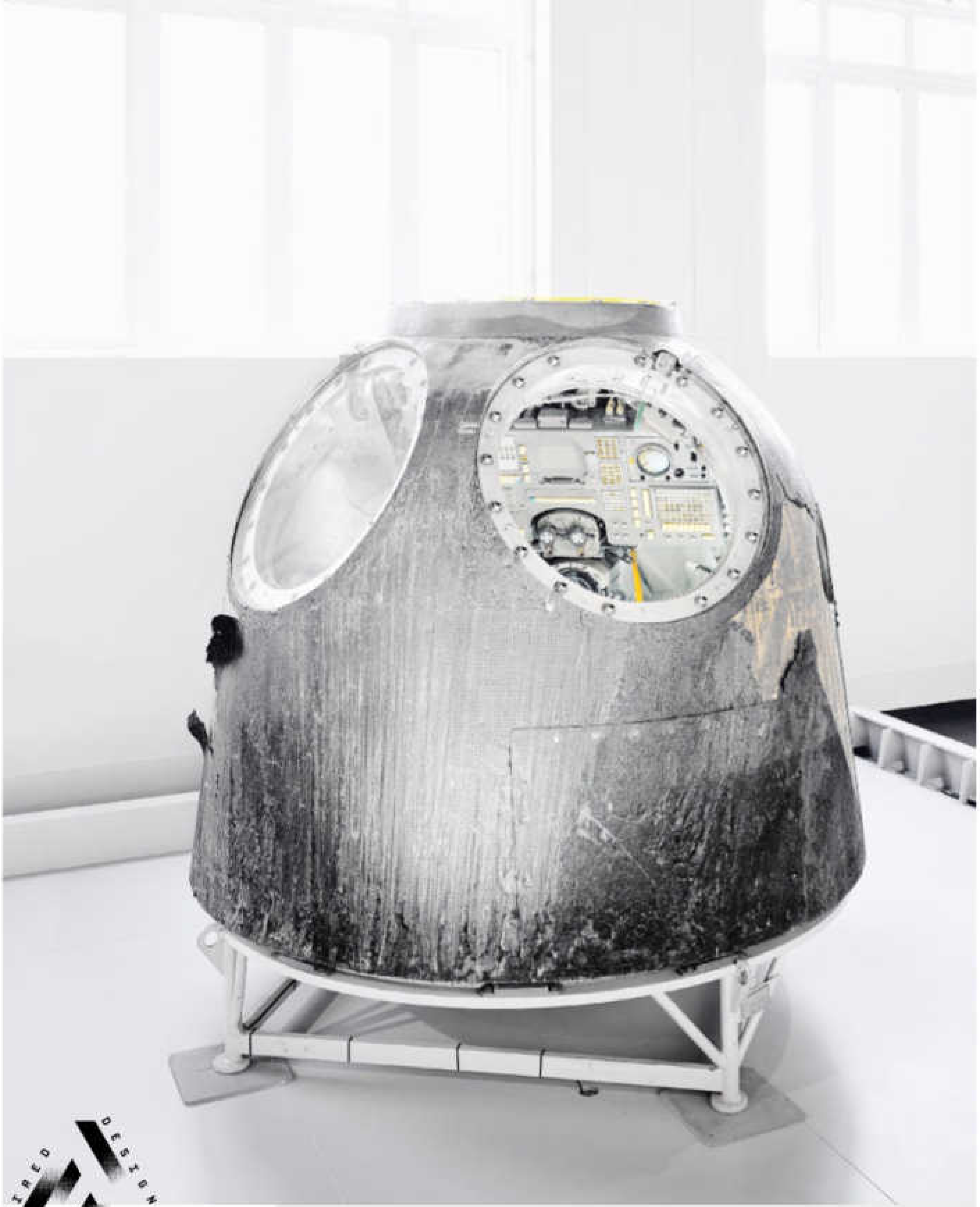
The pieces have been transported from 18 locations, including military bases and aeronautical schools. Russia's space contractor Energia owns the most notable items – the *Sputnik 3* engineering model and the *Vostok 6* and *Voskhod 1* capsules. These are from the era when the USSR achieved record after record (first satellite: *Sputnik*; first dog: Laika; first human: Yuri Gagarin), before being overtaken by the US.

According to Millard, this record-chasing mindset contributed to the Soviet space programme's decline. "They persevered using quite primitive spacecraft in order to grab many firsts, while the Americans were developing the Gemini [human spaceflight project], which was far more sophisticated," he says.

The stripped-down approach was behind some bold engineering choices, such as the landing system of *Voskhod 1* (parachutes and retrorockets), designed because the craft was too small to have ejector seats. "In the mid 60s the Soviet programme ran out of money and became disorganised," Millard says. WIRED takes a tour of its coolest relics. **Gian Volpicelli** *From September 18, sciencemuseum.org.uk* >

SPUTNIK 3

This engineering model shows what the *Sputnik 1* could have looked like. The actual craft, which in 1957 became the first satellite, was a backup solution put together to replace this more conical version. “The rocket to launch it wasn’t quite ready,” explains Millard. “So, in six months [chief USSR rocket scientist] Sergei Korolev and his team designed what we know as *Sputnik 1*, which was much smaller and simpler.” This rejected predecessor eventually made it to space in May 1958, as *Sputnik 3*. Heavily equipped to research Earth’s geophysical properties, it orbited for almost two years.



PHOTOGRAPHY: CHRISTOFFER RUDQUIST

LUNOKHOD

In 1970 and again in 1973, the USSR launched two unmanned *Lunokhod* (“moonwalker”) rovers. The solar-powered vehicles gathered data and carried out tests on the Moon’s surface. They’re still there; this is a model. The rovers were intended as part of Russia’s secret manned lunar programme (aborted in 1970). “They were emergency vehicles to get cosmonauts from the Moon lander to a backup craft elsewhere on the Moon,” says Millard. The *Lunokhod* also included a polonium-210 radioactive source to generate heat. “Important during the lunar night,” Millard says.

SOYUZ TM

Launched in 1992 as the first space mission after the USSR’s collapse the previous year, *Soyuz TM-14* was designed to ferry cosmonauts to the *Mir* space station, and later to the International Space Station (ISS). The last Soyuz TM mission launched in 2002, but its successors are still shuttling astronauts of all nationalities around. “Soyuz is currently the only way to reach the ISS,” Millard says. “It’s the key to the station.” *Soyuz TM-14* – which took on a bronze colour after re-entering the Earth’s atmosphere — was designed for three people. Its space positioning system is an analogue clockwork globe, which determined location by radar and radio waves.

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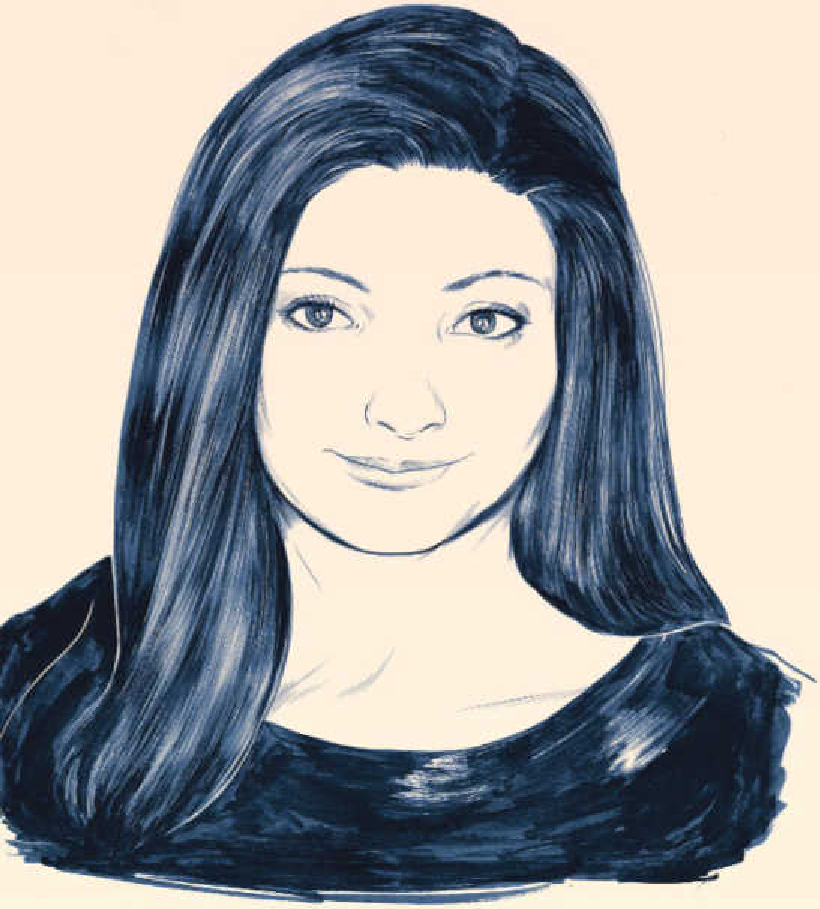
Microsoft Cloud

WHAT WILL PERSONAL COMPUTERS LOOK LIKE IN 20 YEARS' TIME?



RANA EL-KALIOUBY
CHIEF STRATEGY AND SCIENCE OFFICER, AFFECTIVA

"Our devices will have an emotion chip, much like a GPS location chip. It will use optical sensors, and perhaps other sensors, to read your emotions – your facial expressions, tone of voice, your physiology. This chip will also drive actions in response to your emotions. My mirror could sense I am stressed, and communicate this to my social robot, car and wearable phone-watch-health device, so that these adjust the way they interact with me. In this mood-aware internet of things, the emotion chip – always activated with our permission – will make our technology interactions more genuine, authentic and human." **Gian Volpicelli**

WINFRIED HENSINGER
PROFESSOR OF QUANTUM TECHNOLOGIES, UNIVERSITY OF SUSSEX

"With the speed of wireless internet increasing, the location of the actual data processing will not be on your personal device, but on a distant, more powerful machine connected via the cloud. Such computers may belong to the general extremely powerful quantum class that will be developed in ten to 20 years. These technologies will, in just a few milliseconds, crack problems which would take the fastest conventional computer millions of years. Everything from breaking codes to searching data sets to the creation of new materials."

DENISE GERSHBEIN
EXECUTIVE CREATIVE DIRECTOR, FROG DESIGN

"Personal computing has come to be defined first by an individual's unique social access to the internet, and then by the device they use. It follows that, ten years from now, personal computing devices won't be singular and personal. They'll be more distributed as points of access: screens, sensors, data, processes and platforms. It will not be the watch on your wrist or the phone in your pocket. Your personal computing 'device' will be your digital identity, used like a key to enter the system from any number of screens and actions."

CHARLES M LIEBER
PROFESSOR OF CHEMISTRY, HARVARD UNIVERSITY

"Personal computing will become very, very personal. Currently, our interface is through the peripheral nervous system – input by touch and voice; output to eyes and ears. In a very personal future, we would work directly from our brains, integrating 3D nanoelectronics with our neural networks. We have already created the blueprint for 'innervated' or cyborg tissue and recently shown how electronics can be injected into and intermingled with the brain. To modify Descartes's '*cogito ergo sum*', my future of computing is, 'I think, therefore it happens'."

ANDY ADAMATZKY
DIRECTOR OF THE UNCONVENTIONAL COMPUTING CENTRE, UNIVERSITY OF THE WEST OF ENGLAND

"Personal computing will become intra-personal and intra-cellular. Each human neuron will be hijacked by a self-growing, self-repairing, molecular network. Computers will be networks of polymer filaments growing inside and together with a human. 'Seeds' of the networks will be injected into embryos in the first month of their development. They will form a gigantic network inside the brain. Computers will be inside us. They will span all living creatures in a united computing network."

ILLUSTRATION: GUY SHIELD

This cloud opens one stadium to

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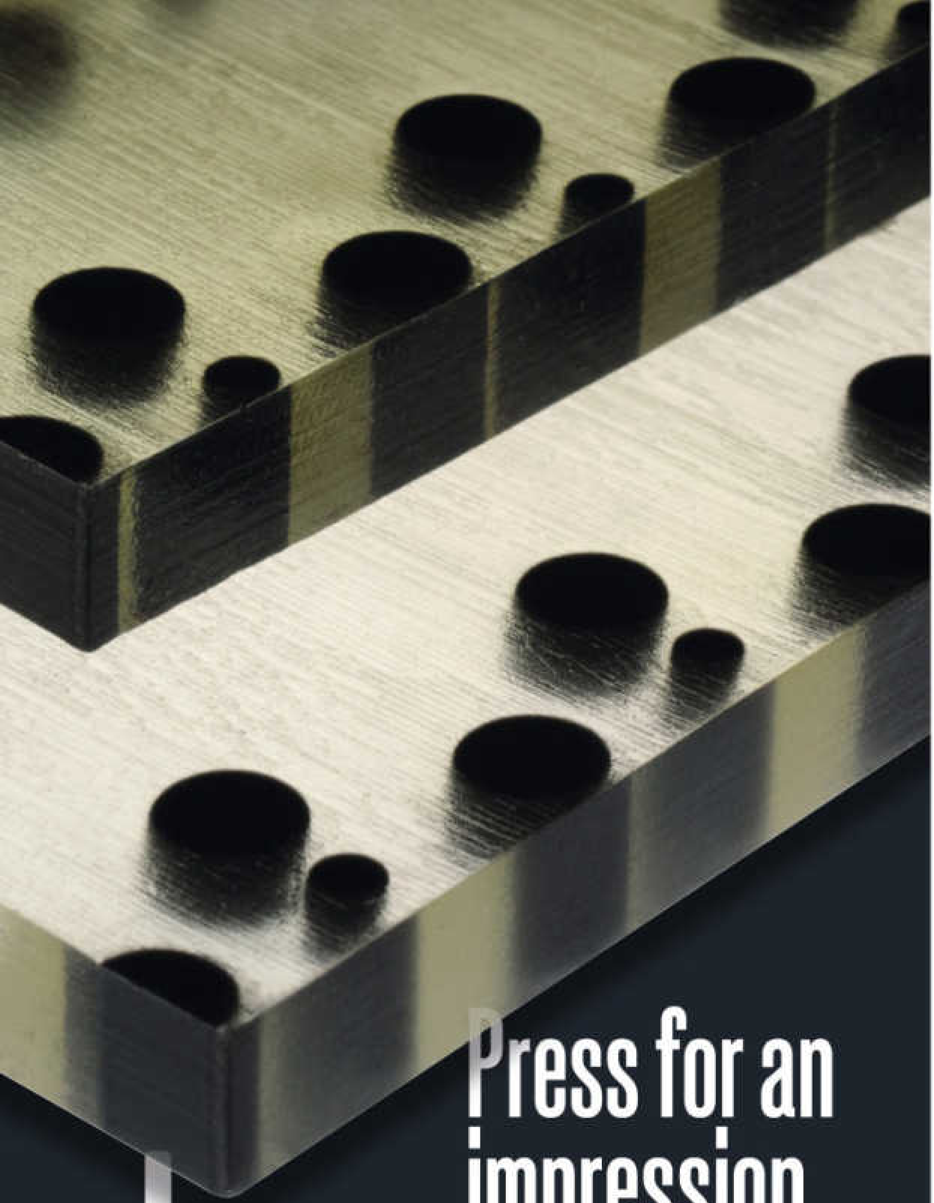

Press for an impression

The material that morphs from smooth to bumpy at a touch

This unnamed material is a shape-shifter: it can transform from smooth to bumpy and back in seconds. MIT engineers Mark Guttag and Mary Boyce wanted to create something that mimicked cuttlefish, which can change colour and texture. The goal: a composite whose harder particles are embedded within a flexible polymer matrix. When this is compressed, the hard particles create bumps and ridges – and disappear after. “We used ordinary plastic polymers," says Guttag. "The important thing was figuring out the right difference in stiffness between the matrix and particles.”

Applications range from hydraulics to aerodynamics. The material might be tuned to change depending on wind speed to minimise drag, or the bumps could act as switchable canals to guide water. Unlike other adjustable materials, Guttag’s invention allows designers to engineer very diverse geometrical features on distinct portions, making for highly customisable surfaces.

The challenge is devising more intricate designs. “So far, the bumps create only two-dimensional patterns,” Guttag says. “Adding a third dimension would be the next major step.” **Gian Volpicelli** *mit.edu*

Digital extra!
Download the WIRED app to watch a GIF of the material morphing

EARLY ADOPTERS

WHAT’S EXCITING…

EMMA OWENS

COO,
Rormix

“Recently, when looking for a new pair of glasses, I used **Cubitts** (after dismissing dull high-street options). Choose four frames: they deliver them for you to try on at home until you’ve made your choice and return them. Then you order the pair that you like online. Easy!”

WHAT’S EXCITING…

SAM AARON

Creator,
Sonic Pi

“I always carry my **Minirig speakers and sub** with me. Their insanely loud hi-fi sound and portability make them perfect for performing impromptu live coded Sonic Pi sets anywhere – from cosy living rooms to dusty warehouses to meadows in the summer Sun.”

WHAT’S EXCITING…

STEVEN KOTLER

Research director,
Flow Genome Project

“To quote William Gibson: ‘I’m a very low-tech guy’ – but I am absolutely in love with my **Franklin-Christoph Model 29 Bellus Rollerball**. It’s a pen… Well, it’s sort of the superhero of pens, and it’s easily the finest writing instrument I’ve ever used (and I’ve used plenty).” **GV**

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The Mitsubishi Outlander PHEV is cutting costs across the country – and if you're one of Britain's average daily drivers you can use just a few drops of petrol each day.

This intelligent hybrid decides when it's more efficient to use petrol or electricity, giving it the ability to deliver a staggering 148mpg[1]. With an electric range of up to 32 miles the Outlander PHEV easily tackles the UK's average daily drive on a single charge – and on longer journeys the petrol engine helps out to achieve a combined range of up to 510 miles[2]. The battery can be charged in just a few hours via a domestic plug socket[3], a low-cost home Charge Point[4] or one of over 7,500 Charge Points found across the UK. With ultra-low CO_2 emissions the Outlander PHEV is exempt from Road Tax and the London Congestion Charge[5] – as well as being eligible for drastically reduced Benefit in Kind taxation[6]. There's even £5,000 off the list price through the Government Plug-in Car Grant, which means an Outlander PHEV will cost you from just £28,249[7], the same price as the Outlander Diesel – and it comes with a 5 year warranty[8].

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1. Official EU MPG test figure shown as a guide for comparative purposes and may not reflect real driving results. 2. 32 mile EV range achieved with full battery charge. 510 miles achieved with combined full battery and petrol tank. Actual range will vary depending on driving style and road conditions. 3. Domestic plug charge: 5 hours, 16 Amp home charge point: 3.5 hours, 80% rapid charge: 30mins. 4. Government subsidised charge points are available from a number of suppliers for a small fee - ask your dealer for more information. 5. Congestion Charge application required, subject to administrative fee. 6. 5% BIK compared to the average rate of 25%. 7. Prices shown include the Government Plug-in Car Grant and VAT (at 20%), but **exclude First Registration Fee**. Model shown is an Outlander PHEV GX4h at £33,399 including the Government Plug-in Car Grant and metallic paint. On The Road prices range from £28,304 to £40,054 and include VED, First Registration Fee and the Government Plug-in Car Grant. **Metallic/pearlescent paint extra**. Prices correct at time of going to print. For more information about the Government Plug-in Car Grant please visit www.gov.uk/plug-in-car-van-grants. The Government Plug-in Car Grant is subject to change at any time, without prior notice. 8. All new Outlander PHEV variants come with a 5 year/62,500 mile warranty (whichever occurs first), for more information please visit www.mitsubishi-cars.co.uk/warranty

Outlander PHEV range fuel consumption in mpg (ltrs/100km): Full Battery Charge: no fuel used, Depleted Battery Charge: 48mpg (5.9), Weighted Average: 148mpg (1.9), CO_2 Emissions: 44 g/km.

Maker for the Moon

Foster + Partners' Xavier de Kestelier designs with VR and lunar dust

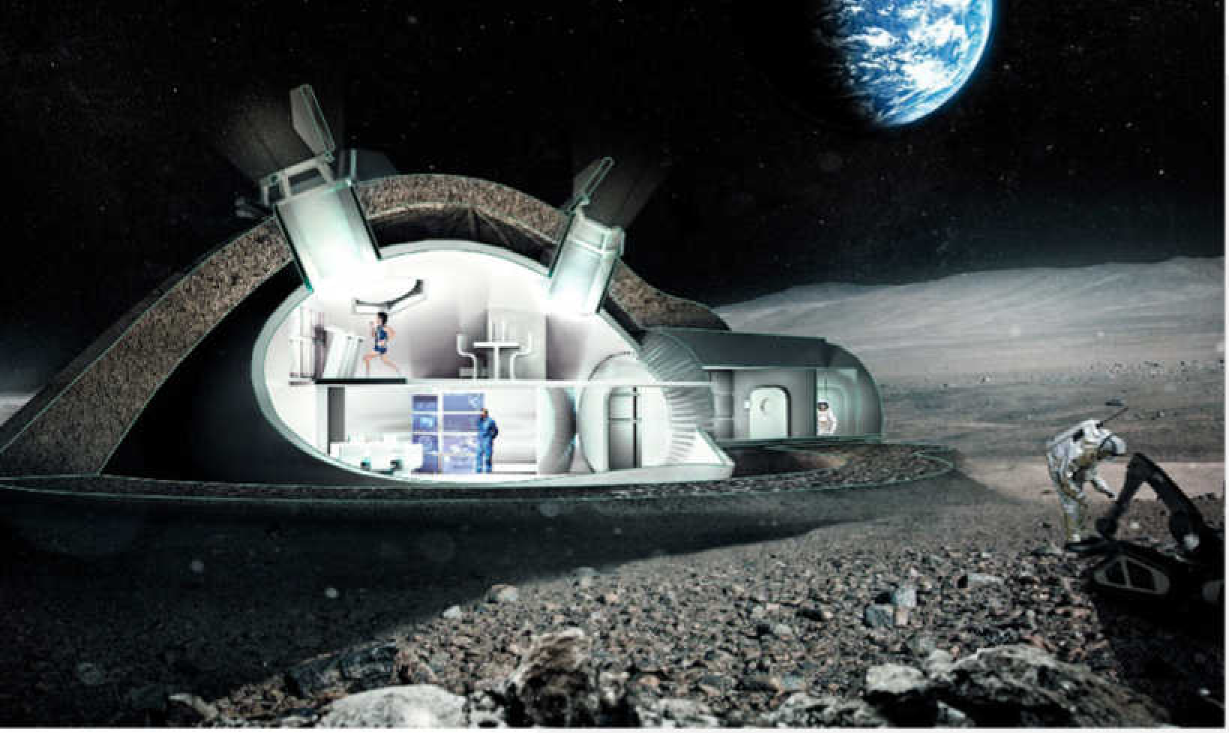
ARCHITECT XAVIER DE KESTELIER LIKES TO experiment with emerging technologies – from laser-wielding robots to virtual reality – as a way to design complex buildings. The UK firm where he works – Foster + Partners – is responsible for some of the world's most iconic buildings, including 30 St Mary Axe, aka the Gherkin, in London, and Hong Kong International Airport. Its latest big project? The new Apple base in Cupertino. De Kestelier co-heads the firm's specialist modelling group: "We were asked by the European Space Agency to design a habitation for the Moon," de Kestelier says. "The result is an inflatable skeleton structure that can be flat-packed, and robots that can use Moon dust to 3D-print a shell." De Kestelier gives WIRED a tour of the lab's coolest projects. **MV** *fosterandpartners.com*

Above: Xavier de Kestelier with a cross-section model of his Moon habitation dome

PHOTOGRAPHY: JAY BROOKS

WIRED: What does your team work on within the larger context of building?
De Kestelier: The team started in the late 90s when we were going to design the Gherkin, and Sage Gateshead. Both are very complex geometrical buildings and we realised we needed some expertise to be able to model them digitally and to fabricate them. The team was formed to come up with strategies on how to make these designs buildable. Although they look curved, they don't have curved elements. The Gherkin is all flat planes and only one curved element on the roof. We also wanted to understand how these buildings behaved according to physics – how the winds flow around them, how they heat up. Our buildings aren't just curvy, they are designed according to certain rules. We needed some high-end analysis tools to understand how environmental parameters were influencing our buildings. So we have two sub-teams of 22 people – one looking at geometry and fabrication, and the other at building physics.

Architects making simulations isn't that unusual...
The team doesn't have just architects – we have engineers, computer scientists, acousticians, aerospace engineers, mathematicians, material scientists, artists and roboticists. All of these people are experts in their own fields, but also digital experts. They have already written their own software to make data modelling easier. For instance Kangaroo, a live physics engine for interactive simulation, was written by our colleague Daniel Piker. Pachyderm, which is a plugin for acoustics, was made by [team member] Arthur van der Harten. >



Top: the Moon outpost has an inflatable living space **Above:** the Molteni dinner table

What tools are currently exciting you?
We are looking ahead to the next big thing that could help us create buildings. The big focus has been augmented reality and virtual reality. How do you immerse yourself in a model? So we've been testing all the headsets that have been coming out, Oculus Rift and others. For example, we were working on a skyscraper, and we wanted to walk the client up to a certain level of a building to show them the views from there, so we used the Oculus Rift. We also have a colleague who uses an Oculus to design with. She was designing a shading device – a louvre system – and she wanted to walk around the building and test out different options, to see the light effect, how much Sun was coming through, whether the views were blocked and to see how well the shading device worked. That's one of the first things we've designed with the Oculus.

Do many of your team projects become part of the larger practice?
We often try out new technologies and see how that can be implemented in our work. 3D printing is a good example. We started that more than ten years ago, around 2004, when we were working on a 42-metre-long motor yacht. We usually create a lot of physical moulds and digital models when planning a structure. In this case, I could make digital models very quickly and accurately, but it was harder to create physical models because it was so geometrically complex. So I proposed buying a 3D printer – we were one of the first architectural firms to buy one. We realised we could use it for any project in the office. It started with me running the machine, but then we spun it off and started a model shop, which is now the largest facility of any architecture firm. It's also the largest set-up of fabrication machines in central London. We make thousands of models each year. It's embedded in the whole practice.

What are some of your most unexpected collaborations?
The European Space Agency was our most interesting collaborator. It was interested in exploring the potential of regolith, or Moon dust, as a material with which to build habitation and shielding on the Moon. The idea was that we would flat-pack an inflatable core and then use 3D printing to build a dome or shell around it, so we could shield the astronauts from gamma radiation from the Sun, micrometeorites that hit at 18kps and protect against temperature fluctuations on the Moon. We designed a device to solidify the dust layer by layer and build it. You usually need a machine bigger than the thing you want to print – but we designed small machines that worked together to build a part bigger than themselves. That was the innovation.

What's your next experiment?
We are doing trials to see how robots could help us in our design process. One project was a creating a pressed metallic table for Italian furniture manufacturer Molteni. We were unable to make a digital model – it was all dependent on the physics of the deformations of the metal, so it was too hard to code. We thought we could use a robot arm to fabricate a physical model which could crush the metal according to different incisions laser-cut into the metal. Based on how we made the cuts, we were then able to get different results. It turned out great. That was the first project and now we are working on others. It's a universal robot – you just get an arm and it can position itself in a point in space very accurately, connecting digital and physical space. That's the essence of all our work – it jumps between the physical and digital worlds, from analysis and simulations, to 3D printing and robots.

ILLUSTRATION: ESA/FOSTER + PARTNERS; NIGEL YOUNG/FOSTER + PARTNERS

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WORLD WAR 3.0 SO FAR...

Cyberattacks have created an invisible but vast war zone

EVERY MONTH, IT SEEMS, a mammoth cyberattack sponsored by a nation state comes to light. In recent years, more than 20 countries have announced their intent to launch or beef up their offensive cyber capabilities. The result is a burgeoning digital arms race that presents a major threat to the security of our data. Here's a look at the countries that have garnered the most headlines during the past few years and a comparison of how their cyber-offensive capabilities stack up. Our assessment is, of course, based only on known attacks. Attribution is tricky. It's difficult, forensically, to distinguish nation-state attacks from those of independent groups – even more so when China and Russia use state hackers and also pay freelancers when they gain access to useful systems. We've ranked a selection of attacks and the players accused of launching them. Amid the intrigue and mystery, one thing is clear – the online world is becoming an increasingly dangerous place. **Kim Zetter**

Nation's offensive capacity

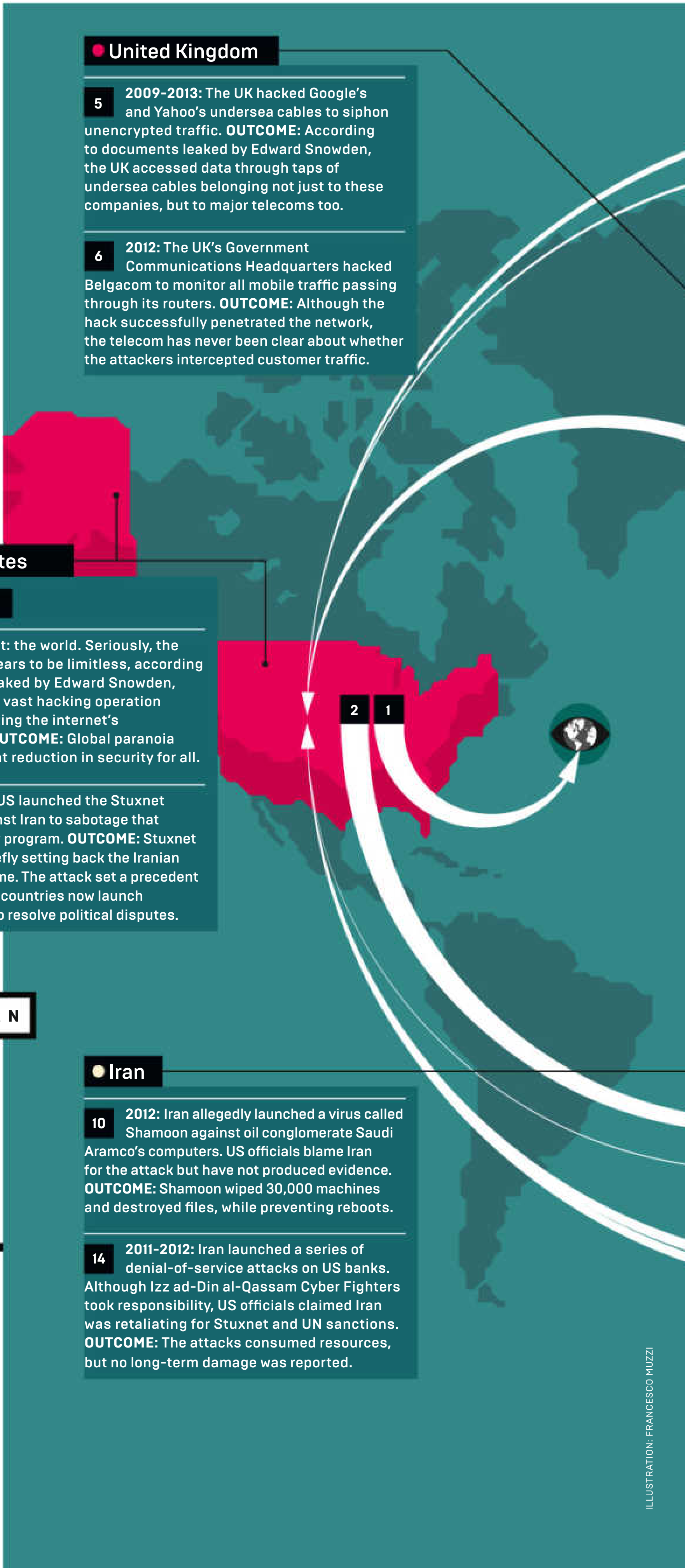
● ● ● ●

HIGH ⟷ LOW

Severity of attack

1 … 14

HIGH ⟷ LOW



● United Kingdom

5 **2009-2013:** The UK hacked Google's and Yahoo's undersea cables to siphon unencrypted traffic. **OUTCOME:** According to documents leaked by Edward Snowden, the UK accessed data through taps of undersea cables belonging not just to these companies, but to major telecoms too.

6 **2012:** The UK's Government Communications Headquarters hacked Belgacom to monitor all mobile traffic passing through its routers. **OUTCOME:** Although the hack successfully penetrated the network, the telecom has never been clear about whether the attackers intercepted customer traffic.

● United States

SEVERITY: **1**

2001-2015: Target: the world. Seriously, the NSA's reach appears to be limitless, according to documents leaked by Edward Snowden, which describe a vast hacking operation aimed at subverting the internet's infrastructure. **OUTCOME:** Global paranoia and a subsequent reduction in security for all.

2 **2007:** The US launched the Stuxnet worm against Iran to sabotage that country's nuclear program. **OUTCOME:** Stuxnet succeeded in briefly setting back the Iranian nuclear programme. The attack set a precedent for cyberwarfare: countries now launch digital assaults to resolve political disputes.

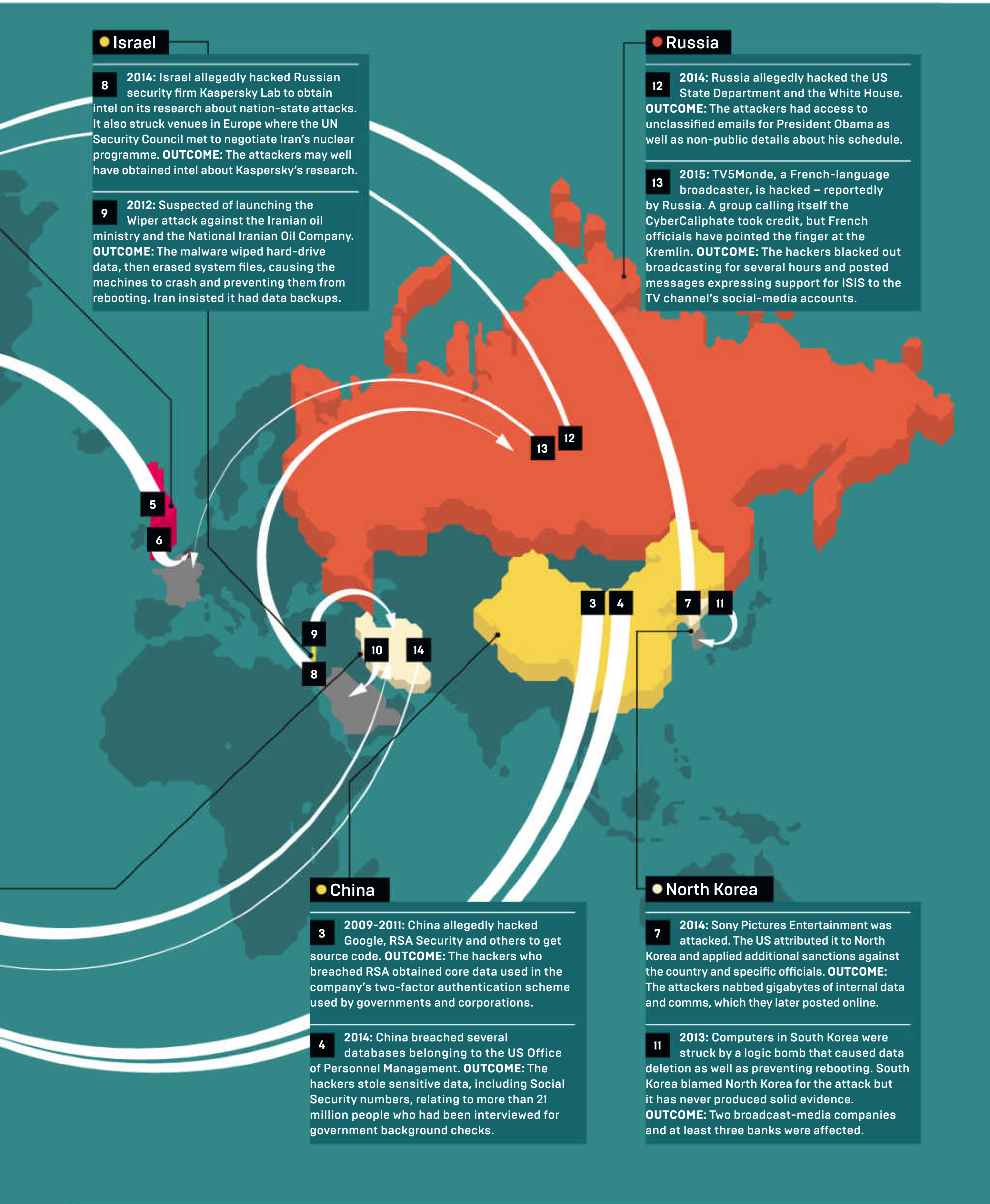
INFOPORN

● Iran

10 **2012:** Iran allegedly launched a virus called Shamoon against oil conglomerate Saudi Aramco's computers. US officials blame Iran for the attack but have not produced evidence. **OUTCOME:** Shamoon wiped 30,000 machines and destroyed files, while preventing reboots.

14 **2011-2012:** Iran launched a series of denial-of-service attacks on US banks. Although Izz ad-Din al-Qassam Cyber Fighters took responsibility, US officials claimed Iran was retaliating for Stuxnet and UN sanctions. **OUTCOME:** The attacks consumed resources, but no long-term damage was reported.

ILLUSTRATION: FRANCESCO MUZZI



Israel

8 **2014:** Israel allegedly hacked Russian security firm Kaspersky Lab to obtain intel on its research about nation-state attacks. It also struck venues in Europe where the UN Security Council met to negotiate Iran's nuclear programme. **OUTCOME:** The attackers may well have obtained intel about Kaspersky's research.

9 **2012:** Suspected of launching the Wiper attack against the Iranian oil ministry and the National Iranian Oil Company. **OUTCOME:** The malware wiped hard-drive data, then erased system files, causing the machines to crash and preventing them from rebooting. Iran insisted it had data backups.

Russia

12 **2014:** Russia allegedly hacked the US State Department and the White House. **OUTCOME:** The attackers had access to unclassified emails for President Obama as well as non-public details about his schedule.

13 **2015:** TV5Monde, a French-language broadcaster, is hacked – reportedly by Russia. A group calling itself the CyberCaliphate took credit, but French officials have pointed the finger at the Kremlin. **OUTCOME:** The hackers blacked out broadcasting for several hours and posted messages expressing support for ISIS to the TV channel's social-media accounts.

China

3 **2009-2011:** China allegedly hacked Google, RSA Security and others to get source code. **OUTCOME:** The hackers who breached RSA obtained core data used in the company's two-factor authentication scheme used by governments and corporations.

4 **2014:** China breached several databases belonging to the US Office of Personnel Management. **OUTCOME:** The hackers stole sensitive data, including Social Security numbers, relating to more than 21 million people who had been interviewed for government background checks.

North Korea

7 **2014:** Sony Pictures Entertainment was attacked. The US attributed it to North Korea and applied additional sanctions against the country and specific officials. **OUTCOME:** The attackers nabbed gigabytes of internal data and comms, which they later posted online.

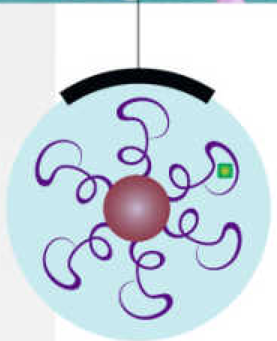
11 **2013:** Computers in South Korea were struck by a logic bomb that caused data deletion as well as preventing rebooting. South Korea blamed North Korea for the attack but it has never produced solid evidence. **OUTCOME:** Two broadcast-media companies and at least three banks were affected.

Take the iconic Fiat 500. Now imagine it even more quintessentially 500. Results include a three dimensional patterned front grille. Just one of many deliciously debonair touches that make the new Fiat 500 even more dapper. By a close shave.

Fuel consumption figures for new Fiat 500 range in mpg (l/100km): Urban 51.4 (5.5) – 65.7 (4.3); Extra Urban 65.7 (4.3) – 83.1 (3.4); Combined 60.1 (4.7) – 74.3 (3.8). CO_2 emissions 110 – 88 g/km. Fuel consumption and CO_2 figures based on standard EU tests for comparative purposes and may not reflect real driving results.

THE SECRET TO CLEANER WATER: MORE PLASTIC

Chemist Abby Knight has found a shiny new way to filter chromium out of groundwater



Our waterways are teeming with plastic waste. Some five trillion bits now clog the world's oceans, ending up in everything from deep-sea sediments to plankton guts. Nobody wants all this rubbish – except chemist Abby Knight, that is. In fact, she's adding more.

Since 2011, the 26-year-old post-doc, now at the University of California, Santa Barbara, has been building a vast library of plastic microbeads – each the size of a grain of sand – with a range of special powers. One is the ability to pull hexavalent chromium out of groundwater.

Chromium is nasty. In high enough doses, the industrial byproduct can cause cancer. "Currently we attempt to solve it by saying, 'Don't drink this water and eventually it will diffuse,'" Knight says. But her beads offer a solution. They're coated in peptoids, a class of synthetic molecule she has tweaked to target chromium. When Knight dumps the beads into water, the peptoids' "arms" grab on to the toxic metal, clearing up the contamination.

Of course, some of us don't want to hear that water needs more plastic, and researchers still need to find a way to scoop out these microbeads (along with the ones that originated in your face wash). But with a pinch of chemistry, Knight has turned a filthy pollutant into a potent purifier – a Brita filter for the planet.

Mallory Pickett

TINY BEADS AT WORK
Abby Knight's array of plastic microbeads grab on to pieces of toxic metal (*shown above, in green*) in contaminated groundwater. The balls are doused in a dye to show how much metal each one has absorbed (*see illustration, top*). The darker the pink, the more rubbish they've mopped up.

ILLUSTRATION: CRISTIANO RINALDI; BROWN BIRD DESIGN

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THE WIRED FELLOWS
2015

TALENTS WE THINK YOU SHOULD WATCH

Meet the 13 people chosen by us to be this year's WIRED Innovation Fellows

At WIRED2015, on October 15-16 in London, we will introduce this year's 13 WIRED Innovation Fellows – exceptional individuals, chosen from hundreds of applicants. These innovators have expertise in gastronomy, music, rocketry and more. For our WIRED/The Space Creative Fellows, see p88. Daniel Culpan

RYAN WEED
Co-founder and CEO
Positron Dynamics

Physicist and US Air Force pilot Ryan Weed is developing the world's first antimatter rocket. Working from an old nuclear-fallout shelter, Positron Dynamics uses the energy density of positrons to create an engine that will propel spacecraft faster and further than ever. The hope? That humans will become an interstellar species.

ALISÉE DE TONNAC
CEO and co-founder
Seedstars World

Seedstars World helps to shine a spotlight on emerging entrepreneurs around the world. After starting her career as a product manager for luxury brands at L'Oréal Group, Alisée de Tonnac embraced her own entrepreneurial spirit and took off for a year-long world tour – taking her from Singapore to Switzerland – to set up the competition. She plans to expand the company to 55 cities by the end of 2015.

DANIEL MCDUFF
Principal research scientist **Affectiva**; research affiliate
MIT Media Lab

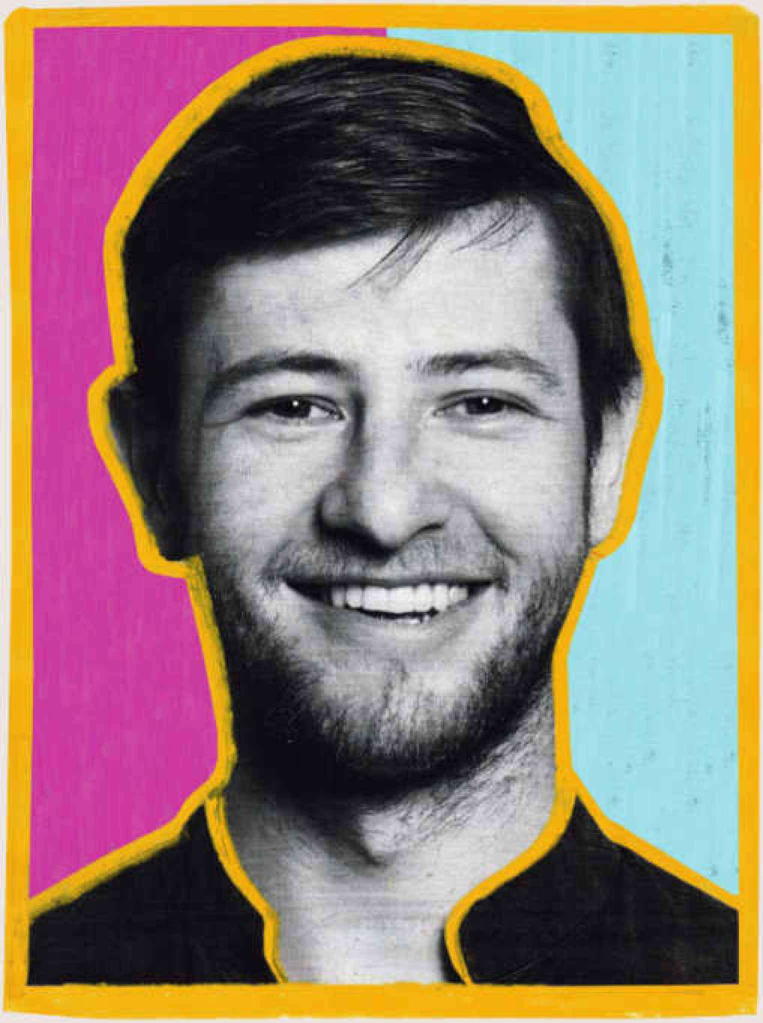
Daniel McDuff is building scalable computer vision and machine-learning tools to enable the automated recognition and analysis of emotions and physiology. His MIT projects have included the Cardiocam – a webcam that can measure vital signs remotely – and Pavlov Poke, a literally shocking solution for social-media addicts.

HELEN KEEN
Comedian and writer

Helen Keen is pioneering space-science stand-up to explore how technology can solve problems. Her Radio 4 show, *It is Rocket Science*, won the 2013 Women in Science and Engineering media award and was nominated for a 2014 Writers' Guild Award.

ILLUSTRATION: JOE CRUZ

THE WIRED FELLOWS
2015



ARTHUR KAY
CEO and co-founder
bio-bean

Arthur Kay has industrialised the process of turning waste coffee grounds into advanced biofuels. The award-winning entrepreneur and designer came up with the idea while studying architecture, and went on to build the world's first coffee-waste-recycling factory after raising more than £3 million in funding. At the age of 24, he was named the youngest *Guardian* sustainable business leader of the year in 2015.

MEG SCHWAMB
Planetary scientist and astronomer

Meg Schwamb won her place for her work in crowdsourcing the search for new planets outside our solar system, as well as the study of Mars's climate. She tackles large astronomical and planetary data sets, and engages with collaborators across the world in scientific research.

CLAUDIO SASSAKI
Co-founder and CEO
Geekie

In 2011, Claudio Sassaki quit a career in finance to pursue his dream of transforming lives through education – and co-founded São Paulo-based Geekie. More than three million students have used the site, which offers personalised learning and study materials.

FREDRIKA GULLFOT
CEO and founder
Simris

Simris is a Swedish-based agribusiness that grows algae. Its goal: to replace fish as a source for Omega-3 supplements – currently, 600 sardines are used for each bottle. Gullfot holds a PhD in biotechnology from the Royal Institute of Technology in Stockholm, and in 2014 was the first woman to be awarded the Swedish Chemical Engineering Prize.

FRANCIS BITONTI
President and founder
Francis Bitonti Studio

Blurring the line between design and technology, New York-based designer Bitonti uses a trademark process that merges digital design and manufacturing technologies. He has pioneered 3D-printing techniques for cellular textiles and multimaterial printing. Oh, and he also designed a 3D-printed gown for Dita Von Teese.

ILLUSTRATION: JOE CRUZ

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THE WIRED FELLOWS
2015

ELIZABETH STOKOE
Professor of social interaction
Loughborough University

Stokoe analyses the science of conversation, including first dates and police interrogations. Outside the classroom, she runs workshops on her "Conversation Analytic Role-play Method" with doctors, the police and other professionals. She's also lectured at the Royal Institution, and her research was featured on Radio 4's *The Life Scientific*.

FREEMAN OSONUGA
Front-line Ebola doctor
Health Corps

Freeman Osonuga worked in Sierra Leone for six months as part of the African Union's Ebola fever response team. Deployed by the Nigerian government in the fight against the epidemic, Freeman is also founder and director of the Heal The World Foundation Nigeria.

ARUNIMA SINHA
World's first female amputee to climb Mount Everest

Former national-level volleyball player Arunima Sinha had her leg amputated below the knee after being thrown on a train track. Two years later, she was the first female amputee to climb Everest. She will speak at WIRED2015 as part of our exchange with India's INK conference.

LINING YAO
Material and interaction designer
Tangible Media Group, MIT Media Lab

Chinese-born Lining Yao researches the intersection of novel materials, digital fabrication and interaction design. She coined the term "material logic" to compute a material's shape, colour, stiffness, texture and density. Before MIT, she was involved in local design and the manufacturing industry in Shenzhen and Hangzhou as a design consultant and entrepreneur.

GET TICKETS FOR WIRED2015, at Tobacco Dock, London, on October 15-16. Book now at **wired.co.uk/15**

APPS OF THE MONTH

MAPSTR

WIRED

You may not think you need another maps app in your life, but you're wrong. If you want to look at your version of the world, complete with notes and tags, you need *Mapstr*. It lets you plot your favourite places, restaurants, shops and other important locations in your life, and then share them with your friends. *iOS, free mapstr.com*

DELIVEROO

Takeaways have never been more appealing since the launch of *Deliveroo*, which lets you order food from hundreds of restaurants and then have it delivered to you. It has built relationships with many of the UK's most popular restaurants in 14 cities. Delivery is £2.50 – often less than the cost of a tip. *iOS, free deliveroo.co.uk*

NINE

This is a visual to-do list for people who want to use their cameras to create reminders. Attached to each snap is a tag such as "Buy", "Watch" and "Go", giving you a distinct list of actions to take. The app also geotags the pictures, allowing you to remember where you were when you captured the photo. *iOS, free nineapp.co*

TRACES

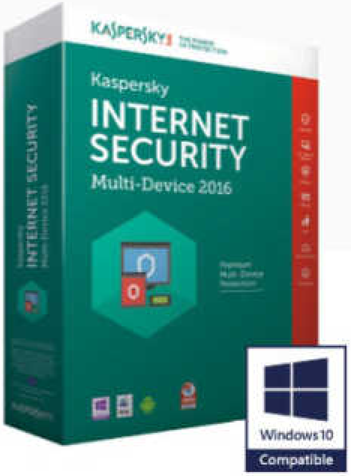
Messaging app *Traces* bridges the gap between the physical and virtual worlds by allowing you to leave digital surprises in real-world locations. Instead of sending a picture to a friend, you send it to a physical place, and the recipient then has to visit that location with their phone to collect it. *iOS, free traces.io*

TINDOG

WEIRD

There are lots of matchmaking tools for humans; now it's dogs' turn. *Tindog* lets you find other dogs (and their owners) around you, giving you and your canine the opportunity to make friends. Once you've matched with another owner you can chat and share photos with one another. *iOS, Android, free tindog.co* **Katie Collins**

ILLUSTRATION: JOE CRUZ



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KASPERSKY lab

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OF PROTECTION

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when you really need it,
only on our network

#4GEntertainment

Vodafone
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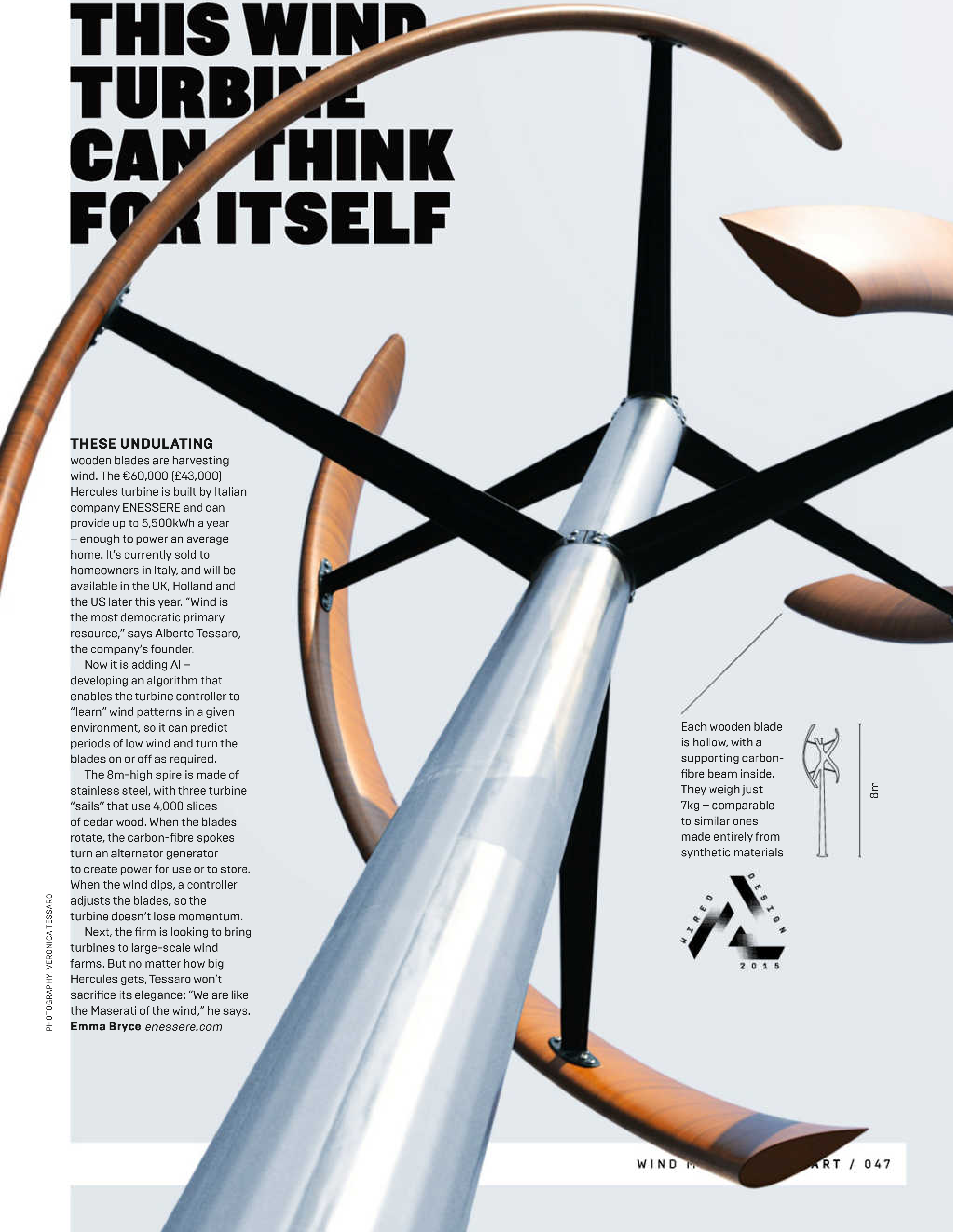
NOW TV
ENTERTAINMENT Pass

Minimum-term agreement and credit checks apply. **Entertainment:** available on 12- and 24-month RED Value bundles (excludes RED Value 2GB bundle). Compatible device required. **Sky Sports Mobile TV:** Sky Sports 1 & 2 and Sky Sports News HQ only. Content may vary. Entertainment will automatically renew after initial 6/12/24 months, unless cancelled. **NOW TV Entertainment Pass:** available for RED Value bundle customers. Access to the NOW TV Entertainment service will automatically renew at £6.99 per month after the initial 6/12/24 months, unless cancelled. Retail price paid includes the cost of the RED Value bundle and the NOW TV Entertainment Pass. Offer not available in conjunction with other NOW TV Entertainment Pass offers. NOW TV account set up with debit/credit card required. 18+. UK only. Content streamed via 8B/4G. Full terms at **vodafone.co.uk/entertainment-packs**. **Ultrafast:** Vodafone 4G is typically 3.65x faster than Vodafone 3G. **4G:** limited coverage, see **www.vodafone.co.uk/coverage**

THIS WIND TURBINE CAN THINK FOR ITSELF



THESE UNDULATING wooden blades are harvesting wind. The €60,000 (£43,000) Hercules turbine is built by Italian company ENESSERE and can provide up to 5,500kWh a year – enough to power an average home. It's currently sold to homeowners in Italy, and will be available in the UK, Holland and the US later this year. "Wind is the most democratic primary resource," says Alberto Tessaro, the company's founder.

Now it is adding AI – developing an algorithm that enables the turbine controller to "learn" wind patterns in a given environment, so it can predict periods of low wind and turn the blades on or off as required.

The 8m-high spire is made of stainless steel, with three turbine "sails" that use 4,000 slices of cedar wood. When the blades rotate, the carbon-fibre spokes turn an alternator generator to create power for use or to store. When the wind dips, a controller adjusts the blades, so the turbine doesn't lose momentum.

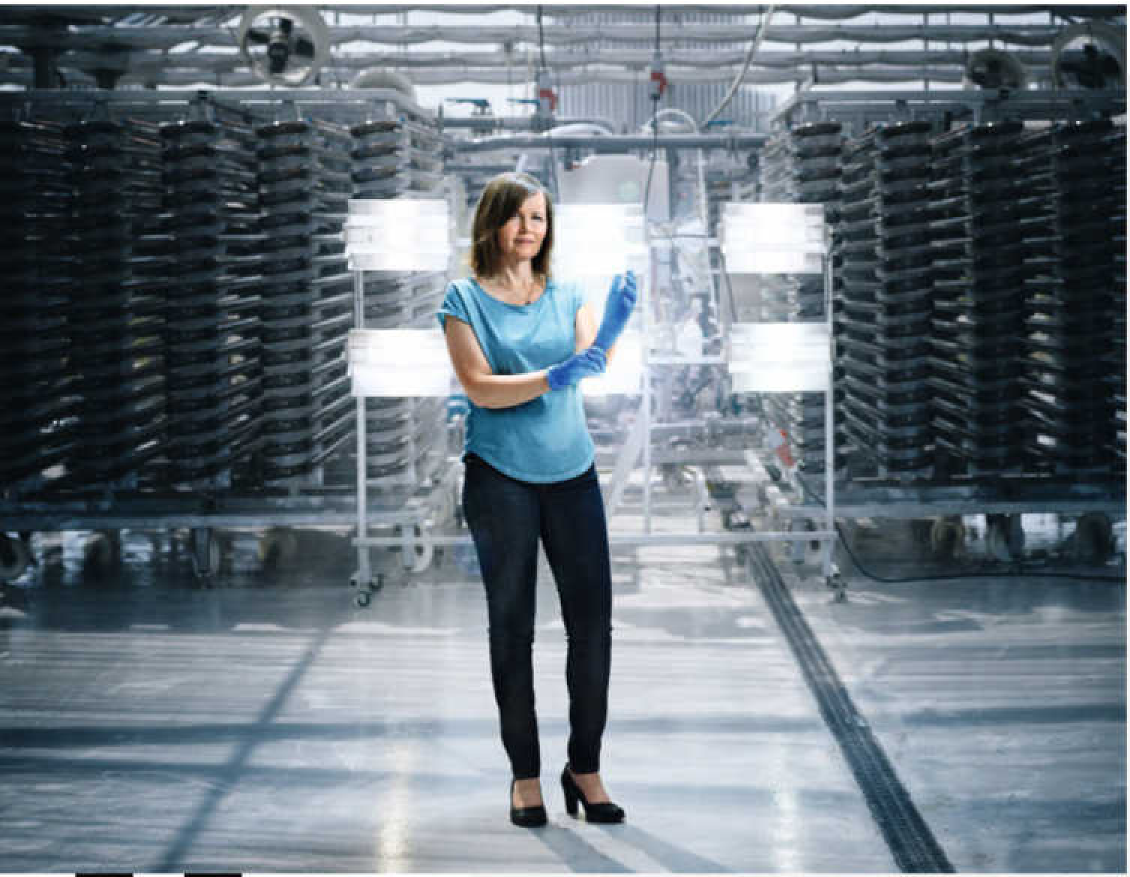
Next, the firm is looking to bring turbines to large-scale wind farms. But no matter how big Hercules gets, Tessaro won't sacrifice its elegance: "We are like the Maserati of the wind," he says.

Emma Bryce *enessere.com*

Each wooden blade is hollow, with a supporting carbon-fibre beam inside. They weigh just 7kg – comparable to similar ones made entirely from synthetic materials

WIRED DESIGN 2015

PHOTOGRAPHY: VERONICA TESSARO



THE HEALTH SUPPLEMENT THAT SAVES THE PLANET

Omega-3 can now be made from CO_2 plus the Sun – instead of overfished sardines

HOW MANY SARDINES DO YOU THINK ARE NEEDED TO MAKE A 500MG bottle of omega-3 health supplement? Six hundred. Fredrika Gullfot wants to change that by swapping fish for algae. As the CEO and founder of Swedish agri-startup Simris Alg, Gullfot had the big idea of using algae to curb one of the biggest drivers of overfishing. "If they're faced with increasing amounts of easily available alternatives, people will be more inclined to switch from fish oil," she says, "and fish-oil omega-3s will essentially become redundant." Her fascination for algae began when she was a graduate student in Sweden bioengineering plants. But when she finished her thesis, Gullfot found there was no Swedish algae industry to work in, so she started it herself – turning a small greenhouse into Sweden's first commercial algae farm for oil production. Unlike her biggest competitor, Gullfot avoids funghi-like algae, which need to be fed sugars to live, grow and breed. "We grow algae that are just like plants," says Gullfot. All they need is sunlight and carbon dioxide, which they convert into fuel and nutrients. "For each kilo of algae we produce, we consume 4kg of carbon dioxide from the atmosphere."

Now Gullfot is expanding. "The market for omega-3s is growing quite fast," she says. With the addition of a $2,000m^2$ greenhouse, she expects to increase production from a few thousand bottles to a quarter of a million by the end of this year – five per cent of the Swedish market. "It's small, but we're getting there," she says. "The cool thing for us is that we have shown that this can actually be done on an industrial scale." **Sophia Epstein** *simrisalg.se*

PHOTOGRAPHY: KEN HERMANN

WIRED	TIRED	EXPIRED
Malware-delivery drones	Postal-delivery drones	**Bomb-delivery drones**
Pentaquark	**Higgs**	Dark matter
echochamber.js	YouTube comments	**reddit**
Emoji movie	***The LEGO Movie***	ASCII *Star Wars*
Escape Dynamics	Copenhagen Suborbitals	**SpaceX**

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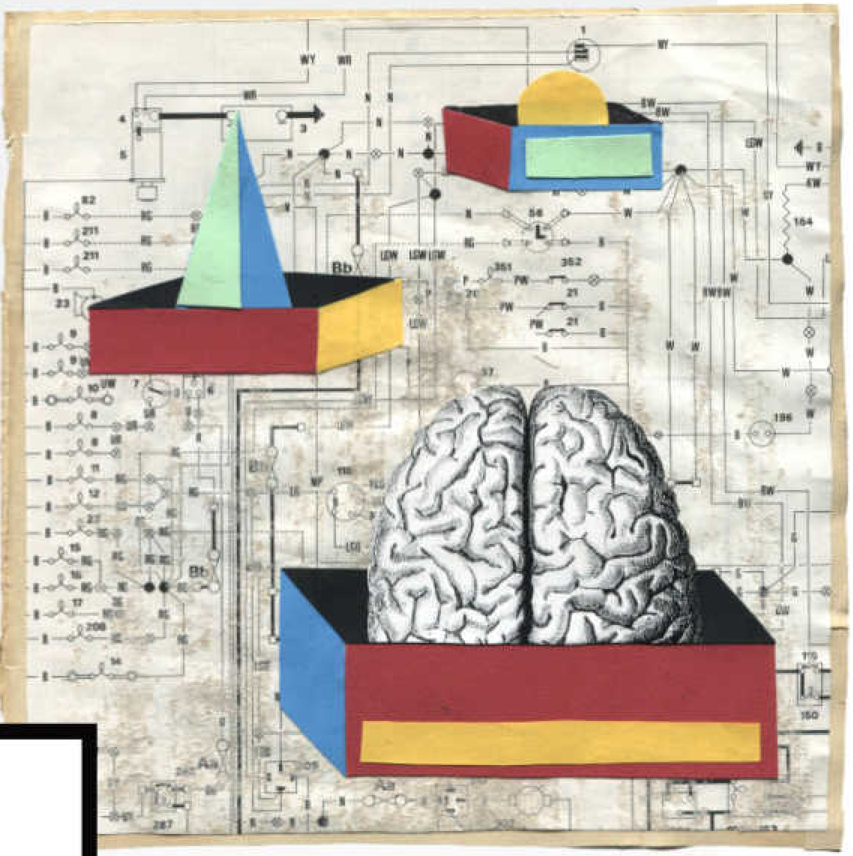
TREND ALERT

3D PRINTING IS A NEW TOOL FOR THINKING



ED SMITH DOES SOME FIENDISHLY DIFFICULT surgeries. A paediatric neurosurgeon at Boston Children's Hospital, he often removes tumours and blood vessels that have grown in gnarled, tangled shapes. "It's really complicated, defusing-a-bomb-type surgery," he says.

So these days, Smith prepares for his work by using an unusual tool: a 3D printer. Days in advance, hospital technicians use standard imaging to print a high-resolution copy of the child's brain, tumour and all. Smith will examine it for hours, slowly developing a nuanced, tactile feel for the challenge. "I can hold the problem in my hand," Smith says. "I can rehearse the surgery as many times as I want." During the operation, Smith keeps the printed brain next to him for reference. As a visualisation tool, it's so powerful that it has reduced the length of his surgeries by an average of 12 per cent.

Smith's work will make you look at 3D printers in a new way. Most of the time, they're pitched as tiny artisanal factories, useful for cranking out one-off products and niche objects: a desktop-sized industrial revolution. But what if it's more? What if the 3D printers are going to be equally useful – or even more so – as *thinking* tools?

The 3D printer's intellectual impact is going to be like that of the inkjet printer. We (correctly) do not regard printers as replacements for industrial presses. Few people print a whole newspaper or book. We use printers as cognitive aids. We print documents so we can array them on our desks, ponder them and show them to other people. That's exactly how Smith uses his 3D printer. He doesn't print the brain so he can have a product. He prints the way you'd print an email – as a document, yes, but more as a way to understand data and solve problems.

'COURTS COULD PRINT FORENSIC EVIDENCE THAT JURIES COULD HANDLE'

Doctors have long used MRIs and CT scans to help visualise tumours. But when the visualisation is physical, it has a haptic impact that screens do not. You learn new things. That's why architects build scale models of their buildings: only by peering around a structure do you "get" what's going on. "You see these spatial relations and depth of field that aren't possible on-screen," Smith says.

It works for more than brains. Last winter, Nasa astronomers printed a model of a binary-star system to help visualise its solar winds. "We discovered a number of things we hadn't fully appreciated," says Thomas Madura, a Nasa visiting scientist. 3D prints are also great for accessibility, giving the blind a new way to grasp astronomy. (Maths, too: an enterprising San Diego father printed fractions so his blind daughter could learn them.)

To really unlock the power of 3D printers, though, the tech will have to improve. If we're going to use physical "documents" the way we use paper ones – glancing at them for perhaps only a moment, then tossing them aside – we'll need printing material to be recyclable, even biodegradable. Imagine the 3D printing equivalent of a Post-it note. What's more, we need our intellectual culture to evolve. We currently don't value or teach spatial reasoning enough; "literacy" generally only means writing and reading.

There can be all sorts of uses for 3D data. Courts could print forensic evidence that juries could handle. You could render a sales report as a sculpture. 3D printers aren't just factories for products – they're factories for thought. **Clive Thompson**

ILLUSTRATION: VALERO DOVAL

Don’t be kept in the dark.

The new Nest Cam Wi-Fi video camera

With Night Vision, you’ll be able to know what’s going on regardless of how much (or little) light there is.

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BioLite HomeStove's disruptive technology offers clean cooking and off-grid electricity to charge mobile phones and LED lights. Here it is in use in Uganda

HOW TO FIX A BURNING ISSUE

THE GLOBAL ALLIANCE FOR CLEAN COOKSTOVES, AND ITS GLOBAL PARTNER BASE, IS WORKING TO INCREASE ENERGY ACCESS AND SAVE MILLIONS OF LIVES BY UPDATING A UBIQUITOUS TECHNOLOGY: THE TRADITIONAL STOVE

We all need to eat. But what if home cooking endangered your family's health every day? That's the case for almost half the population of the planet.

"Globally, three billion people rely on solid fuels to cook, causing serious environmental and health impacts that disproportionately affect women and children," says Radha Muthiah, CEO of the Global Alliance for Clean Cookstoves. "According to the World Health Organization, household air pollution from cooking kills over four million people every year and sickens millions more."

To tackle this vast challenge, the Alliance was launched in 2010 by the United Nations Foundation, the US State Department, and Shell, along with 16 other partners. The public-private partnership aims to achieve large-scale behavioural change by creating a market for clean cookstoves and fuels, and enable 100 million households to adopt clean and efficient cooking stoves and fuels by 2020.

"We're stimulating demand through awareness building and behaviour change, and strengthening supply by developing a pipeline of businesses to supply products that customers value at affordable prices," says Muthiah.

One such business is New York City startup BioLite. In 2006, Alec Drummond and Jonathan Cedar were working as designers for Smart Design, a consumer product development firm. They were both avid campers, but hated carrying gas canisters on the trail, so Drummond began trying to design a clean, efficient wood stove. He realised that by integrating a fan into the combustion system, the stove could burn wood almost as cleanly as gas. Cedar brought his engineering background to the table and the two completed the first prototype BioLite CampStove in May 2008.

The breakthrough innovation came by integrating a thermoelectric generator, which works "like a solar panel for heat," says Cedar. "What we could do is take a bit of waste heat from a fire, turn it into electricity, and power the fan system, as long as you had sticks."

This elegant solution not only created the energy to power clean, efficient combustion, but it also produced extra electricity – enough to charge a phone or power lights. When the team learned that open fire cooking kills more people than HIV, TB and malaria combined, they expanded their focus to the three billion people using such cooking methods. The resulting HomeStove model reduced smoke by 90 per cent, which is estimated to reduce the health risks to its users.

In 2009, Cedar and Drummond quit their jobs to turn their design into a marketable business. They pioneered a new business model called "parallel innovation", in which BioLite designs products with the same core technology for both emerging and established markets – reinvesting revenue from outdoor recreation sales into the emerging markets business, until self-sufficient. Across markets, BioLite has since enabled clean cooking and charging in more than 70 countries. The co-generated electricity has been key in engaging husbands in the stove purchase alongside their wives.

Concurrently, the US EPA's Partnership for Clean Indoor Air, working with the UN Foundation, the Shell Foundation and the US Department of State, identified the need for an independent global initiative to address household air pollution. The Alliance, a multi-stakeholder partnership was developed to address the gaps in funding, awareness, and strategic focus for the sector. Shell Foundation, an independent UK charity set up in 2000 to create new business solutions to development challenges, was beginning to demonstrate how new models for the design, production and distribution of clean cookstoves could operate at scale in Asia and Africa. The move coincided with Shell's identification of access to energy as a key social investment theme.

"What we'd learnt at Shell was that producing energy doesn't always result in universal access to it," says Anna van Remundt, social performance advisor, access to energy at Shell. "We believe Shell can, and should, continue to play a role in enabling energy access by leveraging its resources and investing in innovation. There is no one-size-fits-all solution to energy access. Instead, we need tailored solutions driven by local markets, needs and opportunities. This requires effective collaboration between governments, businesses and others."

Radha Muthiah says, "From day one, Shell has been an effective partner in the Alliance's efforts to support entrepreneurs and raise awareness of this issue."

The partnership between Shell and the Alliance combines Shell's financial pledge of $12 million with in-kind support through participation on the Alliance's Advisory Council, a secondee, and the provision of technical and business skills to assist the Alliance in its goals.

Jennifer Tweddell, Shell's secondee, has helped develop three catalytic enterprise development grant programmes – including the Spark Fund – which are working to raise investor awareness of the sector. The Alliance has attracted over $50 million in grant funding, and calculates that over $58 million in new

BIOLITE HOMESTOVE – HOW IT WORKS

The BioLite HomeStove is as simple to operate as a traditional stove, but comes with significant benefits.

1. Light the HomeStove
To get the stove burning, users feed local fuels – whether wood, cow dung or crop residue – through the side of the stove. Then they light the fire any way they normally would.

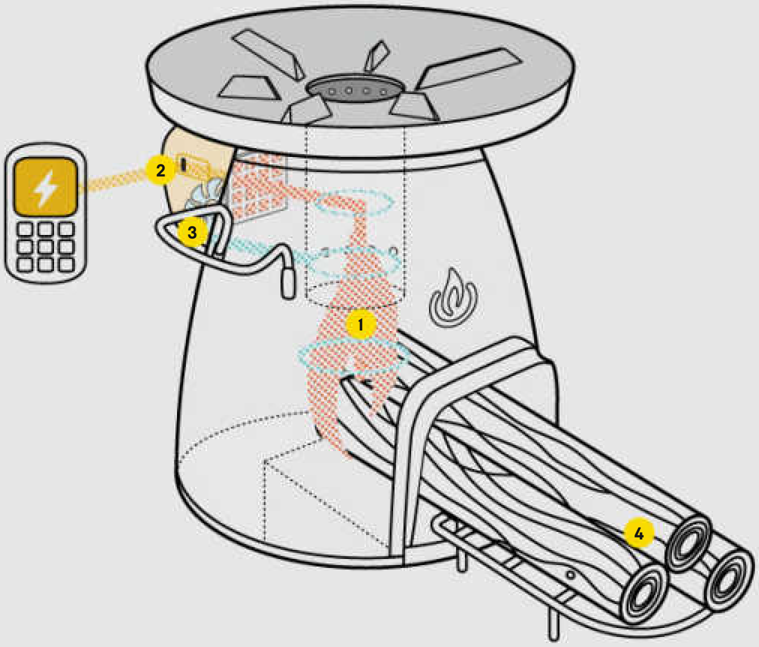
2. Power up the in-built fan
Excess heat from the flame is converted into electricity through a thermoelectric generator. This powers the internal fan and the USB port, for phone charging or LED lighting.

3. Utilise the power of oxygen
The internal fan force-feeds oxygen into the flame, eliminating smoke, and leading to near complete and clean combustion of the solid fuel. The fuel now burns almost as cleanly as gas.

4. Re-fill with fuel as necessary
All the user needs to do to keep the feedback loop going is keep the HomeStove supplied with a viable biomass fuel. This results in an almost limitless energy solution.

> "THERE IS NO ONE-SIZE-FITS-ALL SOLUTION TO ENERGY ACCESS… WE NEED TAILORED SOLUTIONS"

A BioLite HomeStove in use in the village of Gheghta, in Bihar, India



investments to the sector have occurred since the Alliance was launched in 2010.

The Spark Fund, developed by the Alliance in 2012, is a grant facility designed to mirror early stage investment. With a pool of $1-2 million a year, of which $1 million is funded by Shell, Spark aims to help enterprises working in the household cooking sector reach commercial viability and scale. The Alliance leverages Shell's commitment with support from multilateral and bilateral donors such as the Climate and Clean Air Coalition, Germany's Federal Ministry for Economic Cooperation and Development, and Sweden's Ministry of Foreign Affairs.

During each round of the Alliance's Spark Fund, four to six enterprises receive financial support. In partnership with Impact Carbon, BioLite was part of the first round of beneficiaries in a cohort that included EzyLife Kenya, which provides efficient cookstoves, as well as solar lighting and water purification systems. This funding was exactly what BioLite needed to expand into new territories. "Being involved in the Spark Fund provided us with the high risk dollars that were critical to the growth of the company in a new market," says Cedar. In 2013, the Alliance awarded Spark grants to six more enterprises including Greenway Appliances, an Indian-based company with sales of more than 250,000 cookstoves.

The partnership between the Alliance and Shell, and their collaboration on the Spark Fund, have impacted the health of millions, but have also provided climate and gender empowerment benefits. For example, black carbon, which results from incomplete combustion of solid fuel, is estimated to contribute the equivalent of up to 50 per cent of carbon dioxide warming globally, and residential solid fuel burning accounts for up to 25 per cent of black carbon emissions.

"Cooking is a gender issue," says Anna van Remundt. "Women and girls are most affected and, in some regions, spend up to five hours a day gathering wood, or allocate up to a third of their household income on fuel. Using an improved cookstove frees up to 60 days a year for women, and increases in efficiency could equate to enough savings to send two children to school."

But the job is not yet done. According to Radha Muthiah, while the Alliance has made strong progress in developing the sector over the past five years and is on target to reach its mid-term and long-term goals – that of getting cleaner cookstoves into 60 million homes by 2017 and ultimately 100 million homes by 2020 – much work is still needed to tap the full benefit of clean cooking for the wellbeing of the world's population.

"If we get this right," says Cedar, of his BioLite technology and others. "We could see the same kind of global health impact as penicillin." ***#makethefuture***

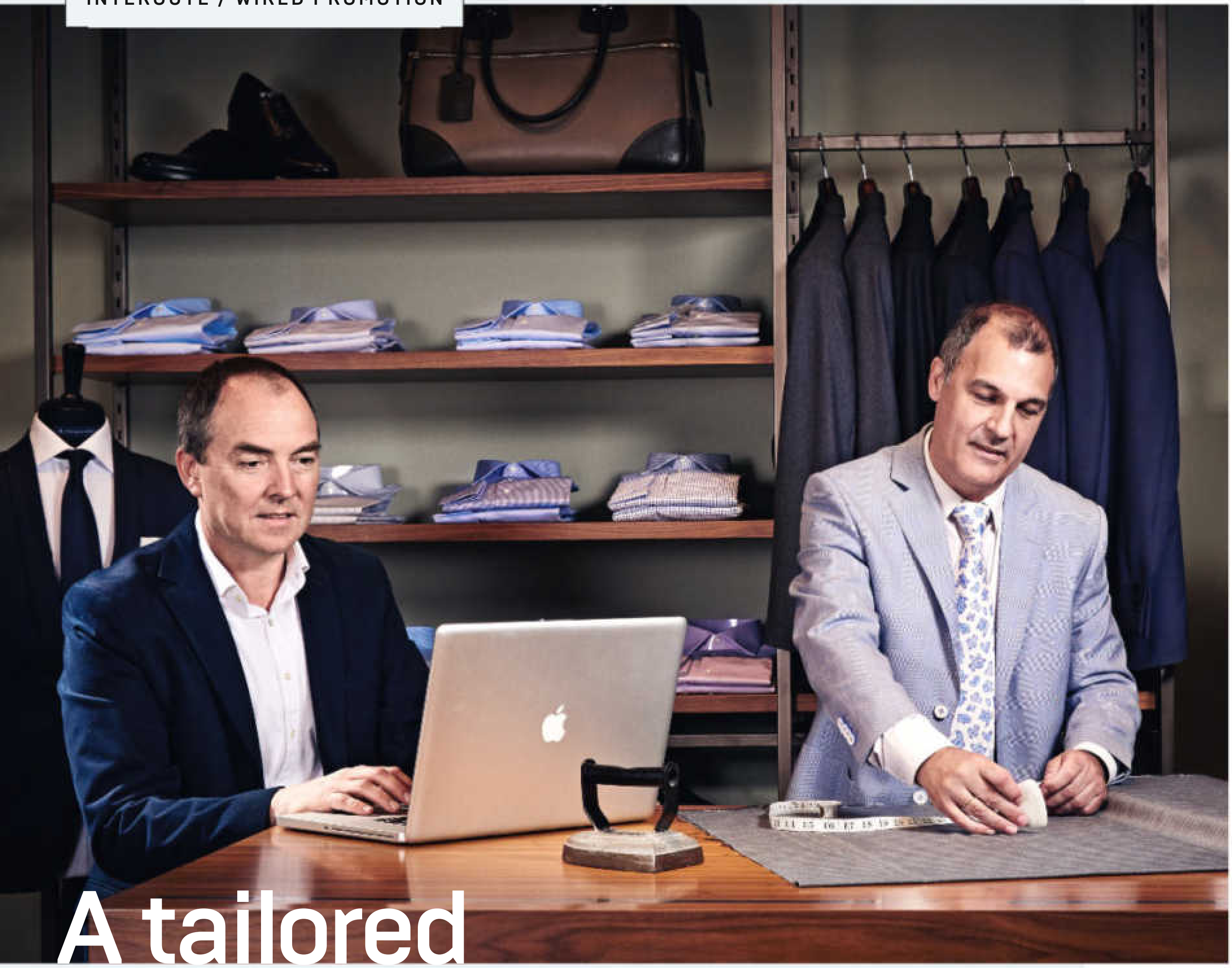
BIOLITE: A SPARK FUND RECIPIENT

The Spark Fund was crucial in helping BioLite co-founders Alec Drummond and Jonathan Cedar explore new markets

Alec Drummond
It was Drummond's initial curiosity and love for camping that started the BioLite story. He wanted to design a stove to be used on trail, without taking fuel.

Jonathan Cedar
A colleague of Drummond's, Cedar gave engineering advice in the project's infancy. His input helped bring the first HomeStove prototype into existence.

The Spark Fund aims to invest $2 million in grant capital annually. The funding is designed to support enterprises with scalable approaches that have the potential to transform the sector. Spark grants target the specific capital and capacity development needs of enterprises across the value chain that have passed the proof-of-concept stage. BioLite was one of several recipients of the grant in 2012. Using the fund, BioLite partnered with Impact Carbon in Uganda to establish and support a national network of distribution and retail partners. This network helped drive the cookstove market in Uganda. It's Impact Carbon's goal to improve health, reduce poverty, and improve local environments while slowing climate change. The partnership resulted in a full scale product launch of BioLite's HomeStove, the fan stove that reduces household air pollution while enabling phone and light charging.



A tailored digital solution

Interoute is enabling thousands of businesses to scale – from the ground to the cloud – on its secure, fast and reliable ICT infrastructure

Matthew Finnie, Interoute's CTO (*left*), with José Largo, Scabal IT director

You may not know the name Scabal, but its likely you've worn the cloth-maker and Savile Row tailor's materials. Similarly, you may not recognise Interoute, but its network has enabled thousands of your online experiences.

Interoute is the owner-operator of Europe's largest cloud services platform and is Scabal's digital backbone. It connects Scabal's online and real-world retail outlets with its manufacturing, enabling Scabal's communications and security systems. That's a complex job. The fabrics are made in the UK, the suits sewn in Germany, the HQ is in Brussels and the cloth is sold to the world's best-known tailors.

Prior to 2013, Scabal's IT – from its servers to security – was managed in-house by José Largo, group IT director (*above, right*). But when Scabal's HQ moved, Largo decided to migrate to Interoute's high-performance cloud platform.

"What was interesting was that we could give the complexity of the networking to another company, who have specialists and could maintain it continuously, without us being worried," says Largo.

Matthew Finnie, Interoute CTO, says companies are shifting from "IT as an overhead to IT as an enabler", and using the cloud for ever-heavier workloads. Yet, whatever they use it for, Interoute's Networked Cloud allows its clients to scale when they need it.

"Using automation and integration, we give our clients the same access to the same infrastructure at the same scale as the largest internet companies," says Finnie.

Now, as Scabal expands into new markets, Largo can focus on his next challenges – without worrying about his servers.

For more, see interoute.com

Enterprise Partner

Interoute is the Enterprise Partner of the WIRED2015 event. It has over 71,500km of lit fibre, 12 data centres, 14 Virtual Data Centres and 31 collocation centres, with links to 195 extra European third-party data centres. The company serves global enterprises, the largest content providers and major European telecoms providers, as well as governments and universities, and major operators in the US and Asia.

PHOTOGRAPHY: JAY BROOKS

GEAR

ISABELL GATZEN HOOK ME UP TABLE

The HOOK ME UP TABLE has an impressive material pedigree: it's crafted from white marble sourced from the same Pentelic quarries used to build and restore the Parthenon in Athens. The use of the stone, however, is far more modern, with a smooth matte finish and clean interlocking base construction. Its smoked glass top highlights the stylish support structure. *€2,800 isabellgatzen.com*

INTERIORS SPECIAL
2015

The table is part of a collection that plays with ideas of light, weight and optical illusion

WORDS: KATHRYN NAVE. PHOTOGRAPHY: WILMA

Next generation

Desirable diversions and distractions for the younger WIRED reader

PLIET LOBBYIST ROCKER

This simple, lightweight chair is made by slotting together flat sections of plywood. These are then pulled together by fastening elements for a more ergonomic, curved shape. Available in a yellow or grey stain with an oiled finish. Custom colours are also available on request. *€360 pliet.com*

The seat-back gets its curve when the bolts are tightened

ID STUDIO PAPER TOOL

Removing any excuse for scribbling on the tablecloth, the walls, or the tax returns, this massive 2,000-sheet A3 drawing pad on castors will never get lost, and can be rolled along. Acting as its own table and allowing two kids to draw at once, it can also double as a stool or a push car. *€159 inka-dropmann.de*

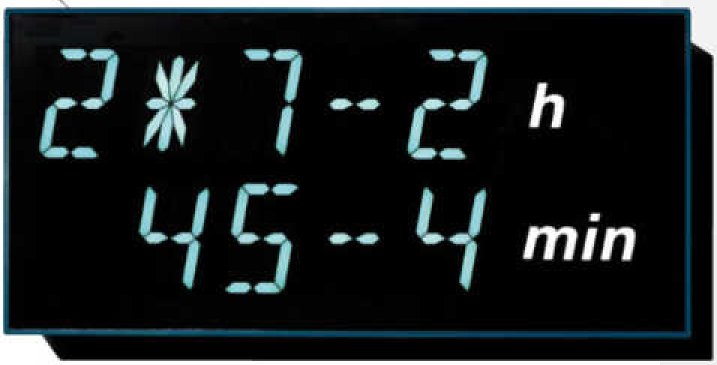
LINA KIDS FURNITURE

Bringing soft play into the home, Lina's colourful collection of foam furniture includes recliners, exercise balls and storage box seats. All of which can be combined and rearranged into multiple configurations. And, because kids shouldn't get to have all the fun, they're also available in adult size. *From €82 linafurniture.com*

MICHAEL NEVILLE CITY TURDS (YIN YANG TWINS)

Constructed from recycled cardboard that's been processed into a pulp, then coloured with natural dyes, these seats are sculpted around a North American hardwood handle. Designer Michael Neville designed his Yin and Yang rockers to be almost entirely biodegradable. *$525 each michael nevilledesign.com*

The clock starts with easy sums that soon get harder



MNTNT ALBERT CLOCK

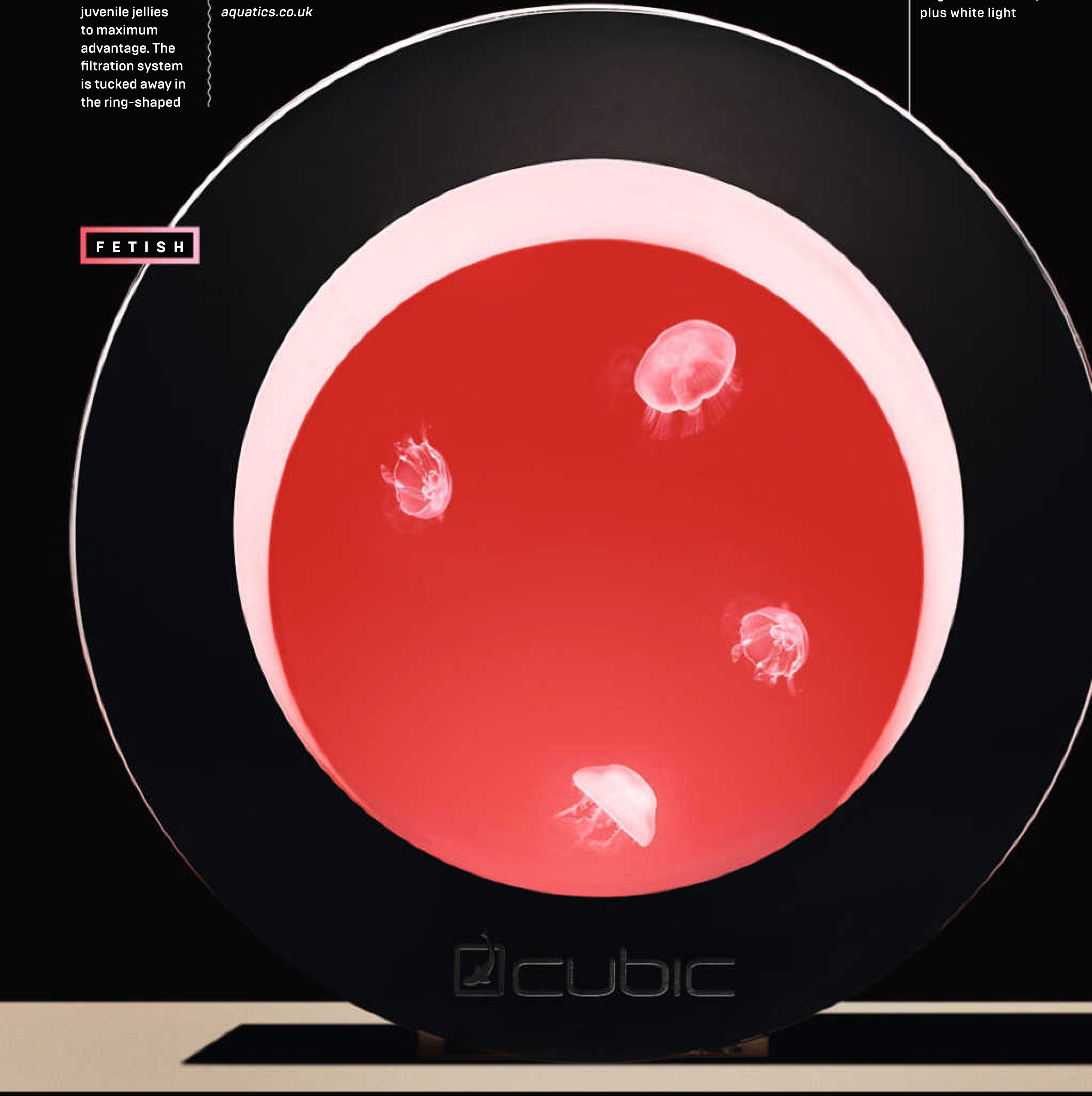
If the kids are not quite ready for their first binary watch just yet, the Albert Clock will keep their mental acuity sharp with four difficulty levels of time-telling arithmetic puzzles. The LED display is custom-built for clear reproduction of mathematical symbols, and the system can be free-standing or wall-mounted. *€200 mntnt.fr*

WORDS: KATHRYN NAVE. PHOTOGRAPHY: MITCH PAYNE; ROGER STILLMAN

FETISH

CUBIC ORBIT 20

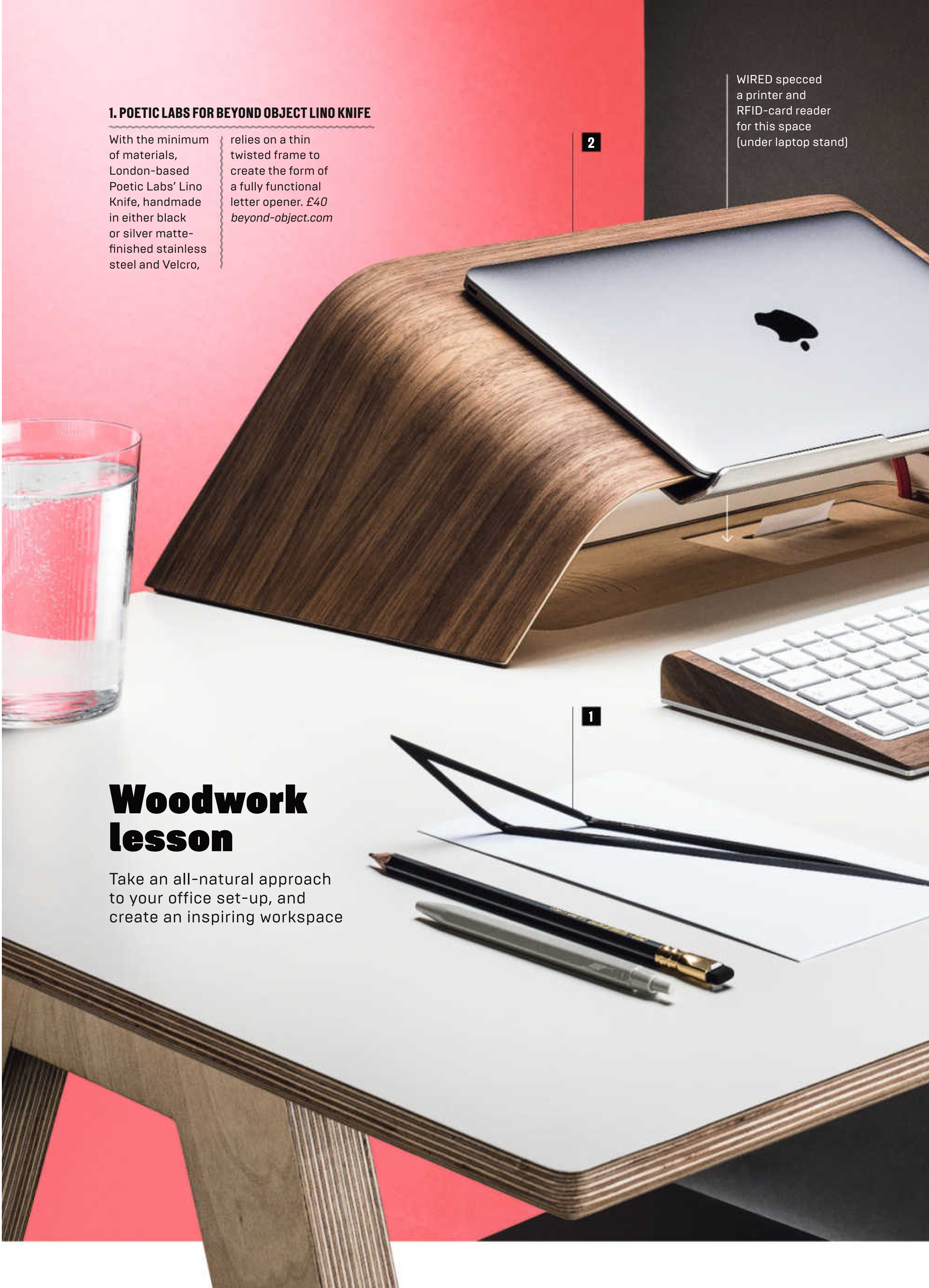
This 23-litre jellyfish tank uses remote-controlled, colour-changing LEDs with a range of strobe-lighting patterns to show off a collection of small or juvenile jellies to maximum advantage. The filtration system is tucked away in the ring-shaped housing, and keeps the water clean and free of unwanted particles by passing it through a sponge filter. *£250 charterhouse-aquatics.co.uk*



Cycle through 15 bright LED colours, plus white light

Woodwork lesson

Take an all-natural approach to your office set-up, and create an inspiring workspace



WIRED specced a printer and RFID-card reader for this space (under laptop stand)

1. POETIC LABS FOR BEYOND OBJECT LINO KNIFE

With the minimum of materials, London-based Poetic Labs' Lino Knife, handmade in either black or silver matte-finished stainless steel and Velcro, relies on a thin twisted frame to create the form of a fully functional letter opener. *£40 beyond-object.com*

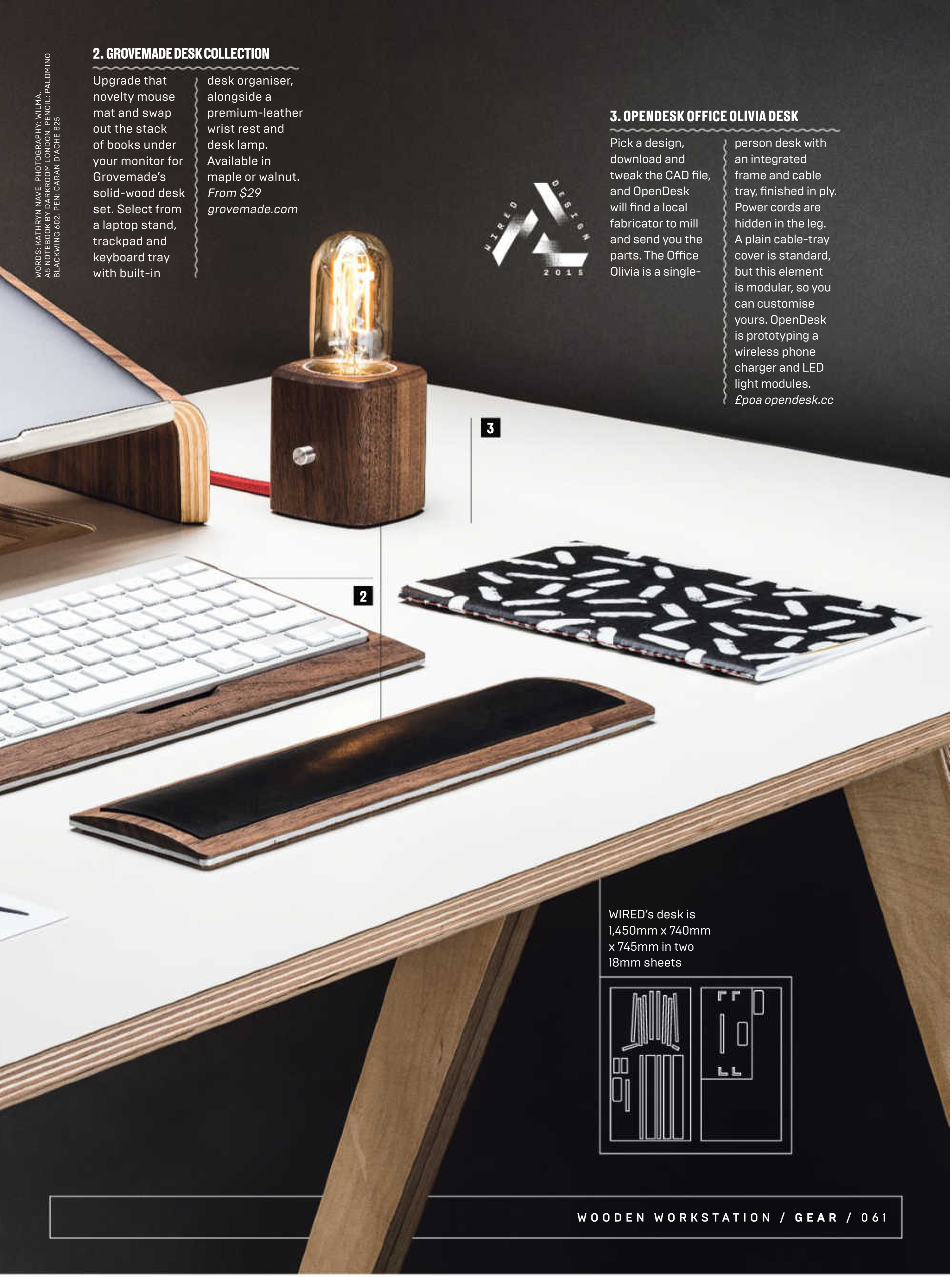
WORDS: KATHRYN NAVE. PHOTOGRAPHY: WILMA.
A5 NOTEBOOK BY DARKROOM LONDON. PENCIL: PALOMINO
BLACKWING 602. PEN: CARAN D'ACHE 825

2. GROVEMADE DESK COLLECTION

Upgrade that novelty mouse mat and swap out the stack of books under your monitor for Grovemade's solid-wood desk set. Select from a laptop stand, trackpad and keyboard tray with built-in desk organiser, alongside a premium-leather wrist rest and desk lamp. Available in maple or walnut. *From $29 grovemade.com*

3. OPENDESK OFFICE OLIVIA DESK

Pick a design, download and tweak the CAD file, and OpenDesk will find a local fabricator to mill and send you the parts. The Office Olivia is a single-person desk with an integrated frame and cable tray, finished in ply. Power cords are hidden in the leg. A plain cable-tray cover is standard, but this element is modular, so you can customise yours. OpenDesk is prototyping a wireless phone charger and LED light modules. *£poa opendesk.cc*



WIRED's desk is 1,450mm x 740mm x 745mm in two 18mm sheets

The WIRED/Audi dinner salon

IN JUNE, WIRED AND AUDI CO-HOSTED A BY-INVITATION VIP DINNER TO DISCUSS HOW NEW TECHNOLOGIES ARE IMPACTING DESIGN AND MANUFACTURE – AND ALSO TO NETWORK AND SHARE IDEAS

An evening in June had WIRED and Audi gather friends of the magazine to discuss how design will impact the future of technology and the ways in which we interact with objects, products and platforms. The event began with a fleet of Audi A8s converging on Vogue House – Condé Nast's UK headquarters – bringing guests to the event comprising dinner, networking and a technology exhibition.

The guest list included an array of respected personalities – many with extensive design credentials. Besides WIRED's editor David Rowan, attendees included Richard Seymour, co-founder of design consultancy Seymourpowell (*opposite*). Wikipedia co-founder Jimmy Wales (*top left*) offered his thoughts and opinions. Designers Jake Dyson (*top right*) and Ross Lovegrove shared conversation; and Eileen Burbidge, partner at Passion Capital, chatted with Bethany Koby, founder of Technology Will Save Us (*far right*).

The evening's goal was distilled in Rowan's introduction: "The only aim is to get an interesting conversation going – and that we all get to know each other." Mission accomplished. *See audi.co.uk*

THE NETWORKING

"Wouldn't it have been fantastic to have been in the 60s, when there were massive innovations in materials and technology? Now we're on the cusp of an even bigger adventure." **Tom Dixon, designer**

"It was a joy to be among such varied and exciting visionaries – Tom Dixon, Richard Seymour, Patrick Grant and Jimmy Wales." **Andrew Diprose, creative director, WIRED**

"Our vision is that all products will be intelligent. At the minimum, they'll be able to tell you how to get more from them, or tell me how you're using it." **Geoff McGrath, McLaren Applied Technologies**

"In the next five years we're going to see more change in our business than the last 50. So we've got to progress rapidly." **Cian O'Brien, head of sales operations, Audi UK**

IN THE TECH SALON…

The evening event included a tech salon bringing together some of WIRED's favourite connected designs. The product exhibition included the following items.

MANUFACTURER	PRODUCT
Naim	Statement Hi-Fi
Meccano Home	Various furniture
Teenage Engineering	Pocket Operators
Avo	Self-Cleaning Fishtank
ROLI	Seaboard GRAND
Audi VR Test Drive	Samsung Gear VR
DxO	ONE Camera
Visualise	VR experience
Micro Drone	2.0 Speed Edition

PHOTOGRAPHY: CHARLIE SURBEY

INTERIORS
SPECIAL TEST
2015

Good vibrations

Which of these latest combination microwave ovens is the master blaster?

A flatbed design allows a larger cooking space

PANASONIC 32-LITRE NN-CF873SBPQ

This achieved the best results with vegetables – they came out nice and moist. On defrost mode, however, it half-cooked the sausage ends but left their centres partially frozen. The choux pastry also needed five minutes longer to cook than the other two models. Michael Wignall found the pastry too light in colour, but he was pleased by the rise and cooking result. In the combi-grill test, the chicken skin was crisp and nicely coloured, but after eight minutes it was still undercooked. "Food shrinkage was kept to a minimum thanks to the slower cooking process," says Wignall. **7/10** *£420* *panasonic.co.uk*

HOW WE TESTED

WIRED enlisted the help of two-Michelin-starred chef Michael Wignall (*above*) to try out three combination microwave ovens in his kitchen at Michael Wignall at the Latymer (pennyhillpark.co.uk). Each was tested for accuracy, performance and ease of use. Choux pastry, chicken and vegetable dishes ensured a variety of settings were used.

SAMSUNG 35-LITRE MC35J8085CT

This model's HotBlast feature offers an ultra-speedy way to cook, which impressed Wignall. He also liked the Keep Warm setting – a feature found in professional built-in ovens. "Although the carrots came out slightly dry, this model did best in the choux pastry test," he says. It came out golden brown, dry on the outside and moist on the inside, just as it should be. Wignall found the Samsung also delivered the goods in the combi-grill test, with "a crispy chicken skin that retained the juice". It also had the fastest defrost feature, "but it gives a minimum defrost weight of 200g, so you will get inaccurate defrosting results for items smaller than this," he notes. **8/10** *£400* *samsung.co.uk*

Turn the turntable off to accommodate dishes of different sizes

RUSSELL HOBBS 30-LITRE RHM3003

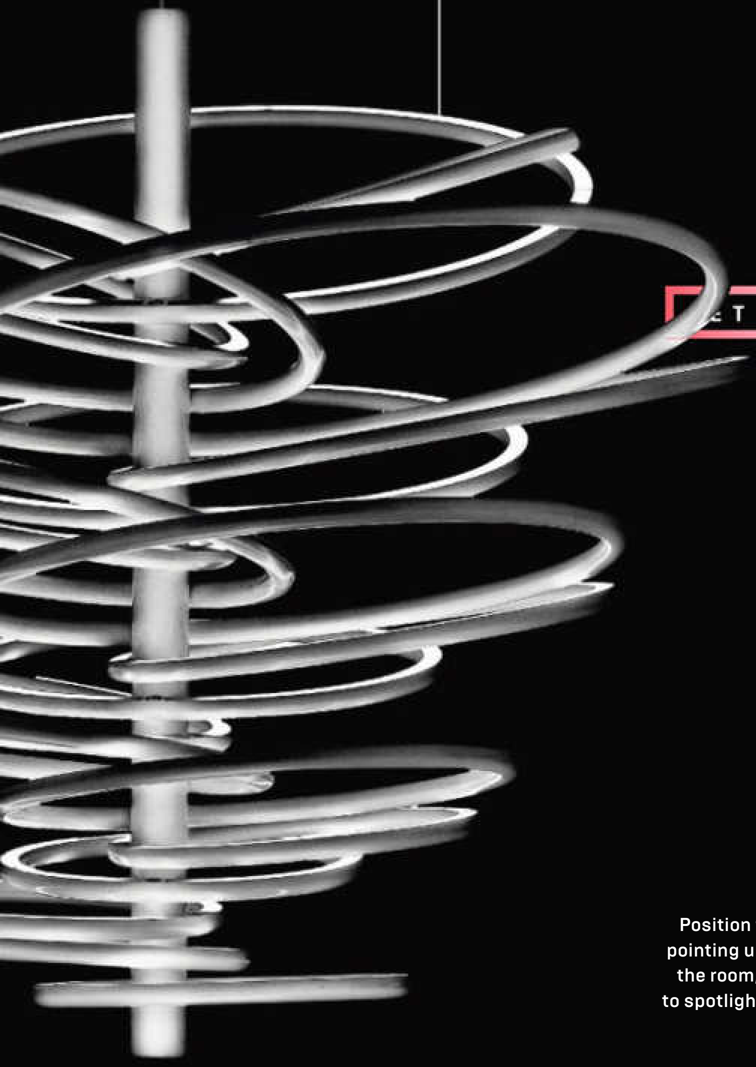
Wignall reported that this model – the smallest on test – had the coolest-to-touch exterior of the three ovens, and thought its size would work well in smaller kitchens. "I like the ergonomic design and stylish white finish," he says. "In convection mode, the carrots came out shrivelled and rather dry inside. And after 20 minutes' cooking, the choux pastry came out undercooked with no rise." Using the combi-grill feature, the chicken needed more cooking time than the other two models as, after eight minutes of cooking, the bird was barely warm. Wignall had to switch to microwave mode for a further five minutes to achieve results he was happy with. **5/10** *£128* *russellhobbs.co.uk*

WORDS: EMILY PECK. PHOTOGRAPHY: DAVE LIDWELL. ILLUSTRATION: GIACOMO GAMBINERI

FLOS 2620

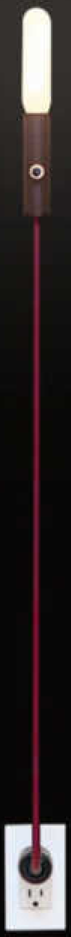
Surrounding a satinised methacrylate diffuser, the white aluminium arabesques of Ron Gilads's 2620 pendant lamp combine with a mirrored disk in the ceiling rose, casting reflected light throughout the room. Measuring 73 centimetres tall, with a four-metre cable drop, the piece is illuminated by a dimmable 200w LED. *£poa flos.com*

Time to reinforce your ceiling: the 2620 weighs a whopping 18kg



CINIMOD STUDIO MOON CHANDELIER

By placing energy efficient OLED layers within 19 hand-polished acrylic spheres, Dominic Harris's Moon chandelier gives 3D volume to this flat light source. Inspired by the phases of the Moon, the illumination of the spheres shifts from crescent to a full, depending on the viewing angle. *£28,000 cinimodstudio.com*



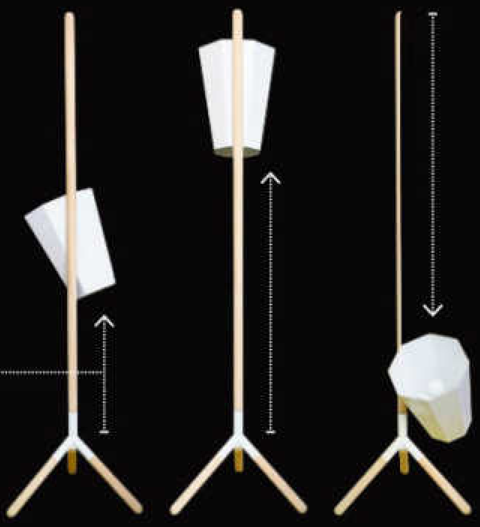
FELTMARK HI·LO

Feltmark's designers pulled a floor lamp apart, then reassembled the core components into a lightweight device that can be anchored into a (US NEMA 5-15p only, for now) plug socket without any extra support. The Wald Hi·Lo's aluminium stand is bead-blasted to a fine texture, then colour anodised in either olive, neutral or plum (*shown, left*). *$159 feltmark.com*

ANTONIO GRAMEGNA SUNFLOWER LAMP

Intended to involve its owner in the design conversation, Italian designer Antonio Gramegna's Sunflower lamp features a central 198cm-high iron pole and a magnetised octagonal-based pyramid lampshade. This can be attached in any position or orientation you choose. *€1,100 antonio gramegna.com*

Position the lamp pointing up to light the room, or down to spotlight an area



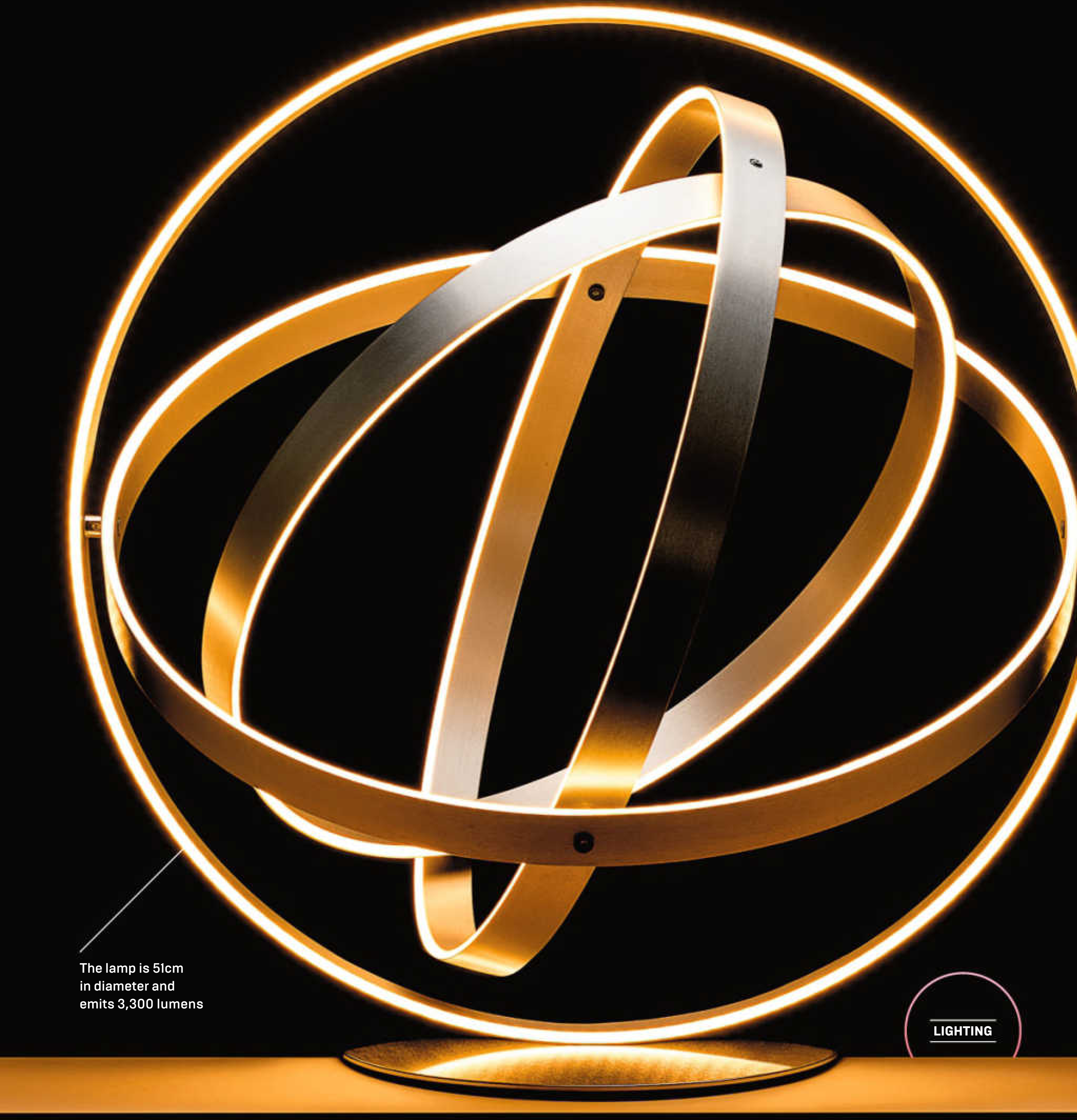
WORDS: KATHRYN NAVE. PHOTOGRAPHY: WILMA

Genius of the lamp

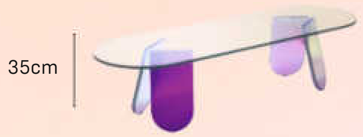
Five smart new takes on illumination

HENRI BURSZTYN B612

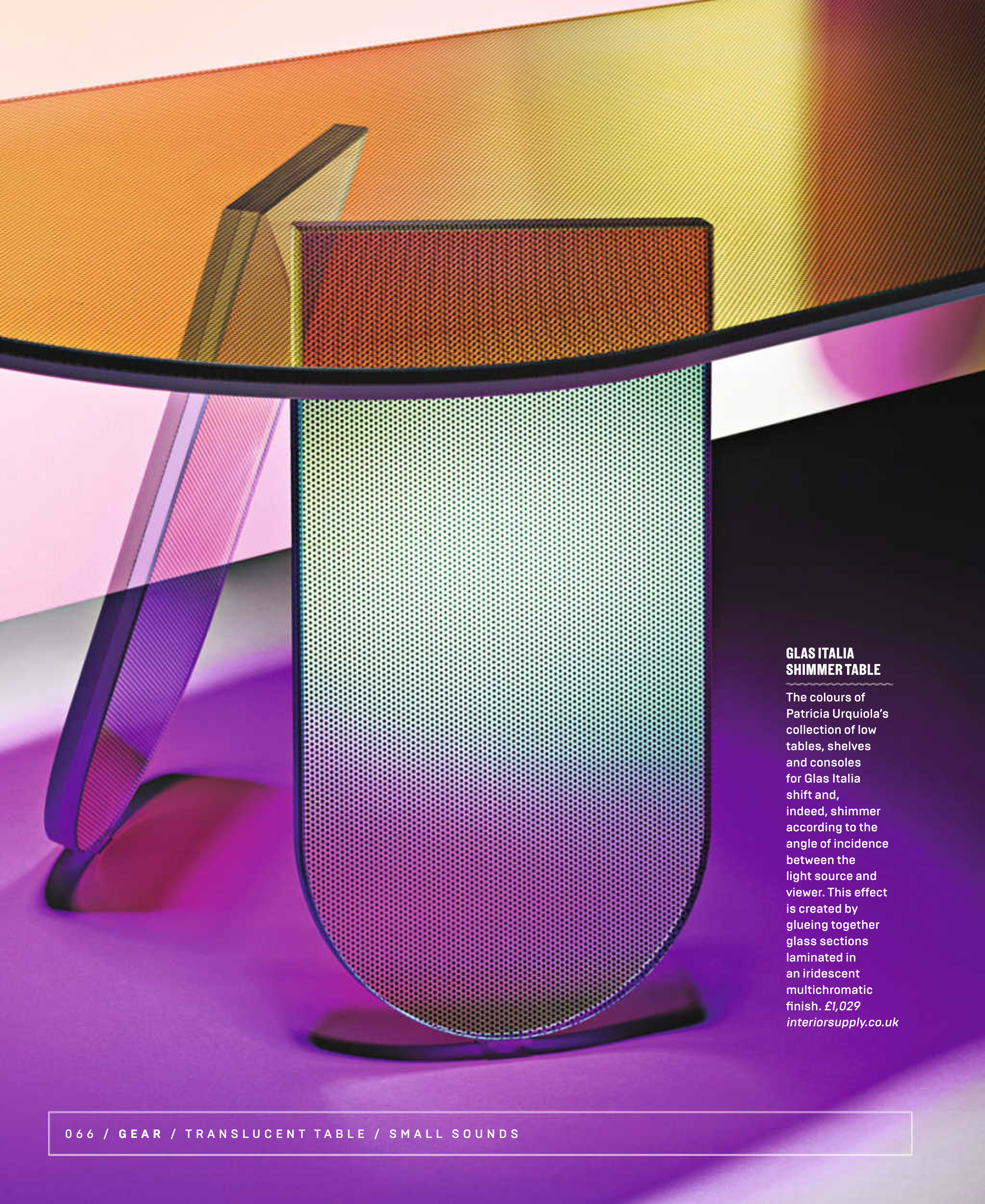
Inspired by astrolabes and named after the protagonist's asteroid home in *The Little Prince* novella, Henri Bursztyn's B612 is constructed from four metal rings that twist independently on their axes. Embedded LEDs along the edges preserve the smooth lines, and the piece can be suspended as a pendant, or used as a table lamp. *€2,275 bursztyn.fr*



The lamp is 51cm in diameter and emits 3,300 lumens



The Shimmer collection is available in opaque, acid etched or transparent glass



GLAS ITALIA SHIMMER TABLE

The colours of Patricia Urquiola's collection of low tables, shelves and consoles for Glas Italia shift and, indeed, shimmer according to the angle of incidence between the light source and viewer. This effect is created by glueing together glass sections laminated in an iridescent multichromatic finish. *£1,029 interiorsupply.co.uk*

INTERIORS SPECIAL TEST
2015

Compressed audio

Which of these mini hi-fis punches above its weight across a variety of formats?

Digital extra!
Download the WIRED app for extended reviews and specs

PANASONIC SC-PMX70

With CD playback and a DAB+ tuner at its heart, this traditional system adds a smattering of cutting-edge compatibility via Bluetooth. It will also play hi-res FLAC files from a USB drive. Build quality is so-so, but its real talents are under the hood, with a third-generation class-D amp that delivers 60W into each speaker. For this price you get a well-imaged soundfield that can go loud without causing aural fatigue. **6/10** *£300 pansonic.co.uk*

CAMBRIDGE AUDIO MINX XI

The Minx Xi eschews physical formats for digital streams delivered over a network with analogue and digital inputs. It's a handsome, solid metal box with 80W of power. Operation is a mixed bag, though, with poorly labelled buttons on either side of a large OLED display. Wi-Fi streaming edges out Bluetooth in terms of clarity, but the digital-to-analogue converter maxes out at 24-bit/96kHZ, so higher-quality downloads won't play. **8/10** *£500 cambridge-audio.com*

DENON DCD-50/PMA-50

No speakers are included here, but the compact DCD-50 CD partners nicely with the PMA-50 amplifier. The minimalist units can be placed vertically or horizontally thanks to auto-orientating OLED displays. CDs play without fuss, and the amp offers a dynamic, refined performance. Bluetooth didn't adopt aptX when we tried, instead using the notably inferior SBC. Much better results were achieved by feeding 192kHz hi-res ALAC files to the USB-A input. **9/10** *£329 (CD); £349 (amp) denon.co.uk*

MUSICAL FIDELITY MERLIN

A record player is the favoured physical medium here – and you can output digitally to capture vinyl in MP3 or AAC on your computer. The amp can handle standard-resolution files via USB, and an optical jack provides 24-bit/96kHz hi-res PCM compatibility. Much like its lacquered finish, the Merlin's performance is highly polished. **8/10** *£1,300 musical fidelity.com*

PIONEER X-HM72

This CD-touting system looks like it was built on a small budget. It does impress, however, especially with its LCD display that shows album art when playing CDs or DLNA-streamed files. It has AirPlay, Bluetooth and streaming with hi-res capability (including top-notch DSD files), but USB or Ethernet are required for 24-bit/192kHz audio. Streaming is unreliable, though, which hampers its otherwise powerful sound. **6/10** *£300 pioneer.co.uk*

HOW WE TESTED

WIRED corralled five mini hi-fi systems with a range of format options and tested each model in a dedicated listening room. We assessed them for ease of set-up, format compatibility, design, build quality and sonic performance. Mini systems provide a convenient alternative to full-size components. CD is still the most prevalent audio storage format, but hi-resolution downloads, streaming services and vinyl are all growing in popularity.

WORDS: KATHYRN NAVE; ADRIAN JUSTINS. PHOTOGRAPHY: WILMA; DAVE LIDWELL. ILLUSTRATION: GIACOMO GAMBINERI

When fashion meets fintech

VISA EUROPE COLLAB HAS PARTNERED WITH DESIGNER HENRY HOLLAND TO EXPLORE THE FUTURE OF INSTANT PAYMENTS. IT'S ALL PART OF A MISSION TO MAKE TRANSACTIONS QUICKER AND EASIER THAN EVER BEFORE

Visa Europe Collab – a new innovation hub – has partnered with designer Henry Holland on a world first.

"I'm working with Visa on a way of incorporating NFC payments technology into the setting of a catwalk show at London Fashion Week," says Holland (*below, right*) in his London studio. "The concept is that people will be able to come to the show [on September 19] and be able to purchase from the models on the catwalk – and then they'll leave the venue with the garments."

The partnership is a 100-day sprint – a concept devised by Steve Perry, founder and co-creator of Collab (*below, left*). "Speed is key," says Perry. "With the 100-day sprint we're creating a collaboration

PHOTOGRAPHY: NICK WILSON

platform whereby we can realise and validate an idea together, giving partners the benefits of the Visa network and its massive scale, all very quickly."

Launched in London on May 1, the Tel Aviv and Berlin Visa Europe Collab hubs opened on May 26 and July 6 respectively. These three hubs have had some 200 startups come through their doors, with 45 entering the proof-of-concept programme, and three in further talks with Visa. It's Perry's aim that each of these ideas should be bold and original.

"What we're doing is very much at the forefront of what's possible with payment technology," says Holland of the NFC catwalk technology (*examples shown right*).

It's the job of Ranjiva Prasad, Collab's technical architect, to marry Holland's vision with what's possible. "This project will test the potential for similar technologies in a retail environment – all of the elements exist in some form," says Prasad. "But theatre is the thing we need to achieve here – because if it doesn't look good or excite, then it's failed." *See visaeuropecollab.com*

VISA EUROPE COLLAB

Visa Europe Collab is a new international innovation hub that works with its partners to offer startups and technology entrepreneurs the insights, tools and connections to transform interactions with payments. "We don't believe a single disruption will suddenly turn the industry over," says Steve Perry, its co-creator. "But, by working with innovators across the payments value chain, we can help shape the consumer experience of the future and Visa's place within a healthy, growing ecosystem." Launched in May, the programme has already produced some exciting results. The first proof of concept to complete the 100-day sprint was a contactless charity donations tin, developed in partnership with Save the Children and the Charities Aid Foundation. The tins work like existing contactless payment terminals, but enable users to donate £1 or £5 to Save the Children using their Visa contactless card. Flypay is another success story. The London-based startup's technology allows restaurant customers to check, split and pay a bill at their table, without needing to find a waiter. Visa Europe Collab's recent collaboration had the startup pivot into the bar and pub tab space, further broadening the appeal of the platform.

IS THE ORIGINAL SUV STILL THE BEST?

Take a closer look at the Jeep Grand Cherokee and you'll begin to see why it is the most awarded SUV* ever.

Look beyond its seductive and assertive appearance, to its inviting and sumptuous interior. Then there's the host of innovative technologies, plus the impressive on and off-road performance. What's more, Jeep built the original 4x4 and is the fastest growing car brand in the UK.^

Until the end of September the Grand Cherokee has even more to offer as seen below. Is the original and most awarded SUV the best? Book a test drive and you decide.

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Model shown is the Jeep Grand Cherokee 3.0 litre V6 Summit at £51,995 OTR. OFFICIAL FUEL CONSUMPTION FIGURES FOR THE JEEP® GRAND CHEROKEE RANGE IN MPG (L/100KM): EXTRA URBAN 28.0 (10.1) – 43.5 (6.5), URBAN 13.6 (20.7) – 30.4 (9.3), COMBINED 20.2 (13.6) – 37.7 (7.5), CO_2 EMISSIONS: 327 – 198 G/KM. Fuel consumption and CO_2 figures are obtained for comparative purposes in accordance with EC directives/regulations and may not be representative of real-life driving conditions. *Claim relates to Jeep Grand Cherokee nameplate over its lifetime. ^Mainstream brand registrations from Jan-June 2014/15. †Promotion available on new Grand Cherokee models registered by 30th September 2015. Jeep Deposit Contribution only available in conjunction with Jeep Hire Purchase. 0% APR Representative Hire Purchase available for a 3 year term with a minimum deposit of 12% required. Complimentary scheduled servicing (excludes SRT) for 3 years or 30,000 miles whichever occurs first, including protection for the first MOT on all qualifying retail sales. Finance subject to status. Guarantees may be required. Terms and Conditions apply. Jeep Financial Services, PO Box 4465, Slough, SL1 0RW. Jeep® is a registered trademark of FCA US LLC.

IDEAS BANK

STEVE SILBERMAN

Why are we still treating autism like an epidemic?

The true cost to global public health of two decades of acrimonious public debate about vaccines is clear in the recent resurgence of childhood diseases, such as measles, that were on the verge of eradication in many countries in the late 20th century. Although the theory that vaccines cause autism has been debunked by multiple studies, the anti-vaccine movement has left behind a much more pervasive and insidious legacy: the notion that autism is a distinctive plague of modern times.

If vaccines are not responsible for the rising number of diagnoses, the reasoning goes, the culprit must be some other threat lurking in our increasingly toxic environment: pesticides, antidepressants in the water supply, Wi-Fi or GM foods. Singer-songwriter Neil Young recently posted to his Facebook wall an MIT computer scientist's absurd claim that Monsanto's herbicide Roundup would render half of all children in the world autistic by 2025. Even Andrew Wakefield – originator of the erroneous study linking vaccines with autism – never went that far.

But it's understandable that people are confused when the messaging even from alleged experts is so confusing. On March 29, 2012, the US Centers for Disease Control and Prevention (CDC) held a press conference to announce that the agency was increasing its estimate of the prevalence of autism among school-age children in the United States from its previous 2006 figure of one in 110 children to one in 88. (The current estimate is one in 68.) The sensible first question asked by a reporter was whether this figure represented an actual increase in the incidence of autism, or was simply a more accurate approximation of the number of cases out there.

CDC director Thomas Frieden ventured that the revised estimate almost certainly did not reflect an actual increase in incidence, framing the new number as a hopeful sign that more autistic children are being identified earlier in their lives, so they and their families can get the help, educational resources and support services they need. The data from the agency's monitoring network backed him up. For example, the CDC's estimate of autism prevalence among white children in Utah was 28 times higher than the estimate for Hispanic kids in Alabama. There's no clinical evidence that white kids are more prone to developing autism than Hispanic ones. The crucial factor is access to healthcare. In Utah, where autism has been tracked closely for three decades, diagnostic resources are widely available, whereas in Alabama, the needs of autistic children and their families in the Hispanic community have been historically under served. The lesson of these numbers is simple: the more public health resources you put in place to look for autism, the more you find it – and autistic people of all ages and their families reap the benefits. Until the 90s, most cases of autism worldwide went undiagnosed or were hidden behind labels such as "mental retardation" and "childhood schizophrenia". When the diagnostic criteria were revised to reflect the diversity of the autism spectrum, the numbers started to soar.

But that morning at CDC headquarters, the press conference took a much darker turn. Mark Roithmayr, then president of Autism Speaks, the largest autism fundraising organisation in the world, pulled out a Merriam-Webster dictionary and proceeded to read the definition of the word "epidemic". "Autism is now officially becoming an epidemic in the United States. We are dealing with a national emergency," he declared, though the agency's panel of experts had said nothing of the sort. In the TV coverage that followed, the revised estimate was widely touted as

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Steve Silberman is the author of *NeuroTribes: The Legacy of Autism and How to Think Smarter About People Who Think Differently* (Allen & Unwin)

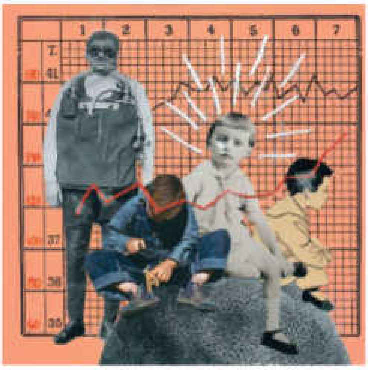


ILLUSTRATION: MAX-O-MATIC

evidence of a "shocking surge" in prevalence. Autism Speaks promptly released a statement claiming that autism dwarfed the threat to children represented by "diabetes, Aids, cancer, cerebral palsy, cystic fibrosis, muscular dystrophy or Down syndrome – combined."

It's not hard to imagine why some autism fundraising organisations and media outlets embrace terms like "epidemic" and "emergency". "We're not using that word to suggest that autism is contagious," says Geraldine Dawson, the former science director of Autism Speaks. "We're trying to get people to pay attention." But not all attention is created equal, and the wrong kinds of attention lead to unnecessary fear and stigma, misplaced research priorities and the misallocation of precious resources. The vast majority of the research projects funded by Autism Speaks are devoted to sifting through the human genome for candidate genes (more than a thousand have been discovered) and adding to an ever-lengthening list of suspected environmental triggers. But the real autism emergency – as any autistic person or their family members can tell you – is the scarcity of services to enable people on the spectrum of all ages to live happy, healthy and productive lives.

In that regard, the UK – where the National Autistic Society (NAS) scrupulously avoids fear-mongering terms like "epidemic" – is far ahead of the United States. Two-thirds of NAS's funding for education and family services goes to meeting the needs of adults. Contrast that to the situation in America, where a measly two per cent of the autism research funded by the Department of Health & Human Services in 2010 was committed to improving the quality of life for adults on the spectrum. When autism is framed as an aberrtion of the modern world, autistic adults are rendered invisible.

The theory that vaccines cause autism has been tossed into the dustbin of history where it belongs. Now it's time to dispose of its toxic legacy.

GURU MADHAVAN

We irrational humans need engineers, not economists

Guru Madhavan is a biomedical engineer and senior policy adviser in Washington, DC. He wrote *Think Like An Engineer* (Oneworld)

Nobel-winning economist Kenneth Arrow once noted that "an economist by training thinks of him or herself as the guardian of rationality, the ascriber of rationality to others, and the prescriber of rationality to the social world."

However, in creating better tools and value for society, engineers trump economists. Why? Rationality aside, engineers design under constraints – most notably the laws of nature and the limits of human knowledge. From the design of satellites to subterranean sewer systems, engineers maximise utility within the confines of what is practical and feasible. Economists also appreciate constraints, and their models and advice have had important consequences. For example, how does health insurance change the way people use medical care, and what is the optimal coverage plan? The fundamental issue, though, is that most economic analyses are built on the dubious assumption that humans make rational decisions.

Economists could learn from the ways engineers deal with less-than-perfect human rationality. Engineers have nuanced capabilities to take human factors into consideration through the long-standing practice of user-centred design – a strategy that economists have only recently begun to appreciate under the name of behavioural economics. Using the power of feedback – a core concept in engineering – user-centred design practices have been exploited to foster new products, services and markets. And, critically, the designs have played a decisive role in influencing behaviour change.

Consider Stockholm. At the turn of the millennium, the city was struggling to control its rush-hour traffic mess. Fortuitously, the city administrators consulted IBM, whose engineers possessed expertise beyond the usual disciplines of civil engineering and urban planning. Instead of proposing the conventional solutions, such as a new bridge or an additional highway, the IBM engineers proposed a congestion-pricing system that dramatically transformed public behaviour by motivating people to think of other transportation choices during peak hours. This solution is a prime example of "design economics", a term championed by Alvin Roth, an engineer-turned-economist. Roth has applied engineering design principles to previously intractable problems such as matching medical residents with hospitals and setting up life-saving kidney-exchange programmes – achievements that led to his Nobel Prize. For

ILLUSTRATION: MARK LAZENBY; EMMANUEL PIERRE

economics to be more useful, economists need to take a comprehensive systems approach just as engineers consider far more than the equations of physics and forces of gravity in designing buildings and bridges. The stability, durability and reliability of these creations depend on the mechanics of supporting materials and other forces, and also on how people use these structures. These types of practical engineering insights are crucial in the redesign of our policy systems that have traditionally relied on the advice of economists. "Engineering is often less elegant than the simple underlying physics," Roth writes. "But it allows bridges designed on the same basic model to be built longer and stronger over time, as the complexities and how to deal with them become better understood."

Engineering and economics have both made vital contributions to society, each with its limitations. Engineers who develop smartphones or aeroplanes may not have the acumen of economists and marketers to suggest business models that lock us into two-year contracts with phone-service providers or earn loyalty air miles. But they do bring the much broader and useful expertise of systems at the junction of humans, technologies and the environment. They also build redundancies, create fail-safe mechanisms and implement continuous improvements: a much better approach than establishing committees or bureaucratic institutions in response to panic.

Through an increased reliance on engineers – or better yet, rethinking economics using the principles of engineering – policymakers can develop more effective solutions to social challenges. In engineering design there's a saying: "In theory, there's no difference between theory and practice. In practice, there is." Grand theories will not repair deteriorating highways or restore public health systems weakened by recent disease outbreaks. We need workable solutions. It's time to give engineers a chance.

SCOTT SMITH

Who cares if a robot wins the Booker?

In early July, the nerdier reaches of Twitter freaked out about the supposed "dreams" of neural networks, with multicoloured spirals of shape and colour rendering hybrid pig-snails and camel-fish. The networks in question belong to Google Research, which has been testing different ways to teach these networks to visually recognise shapes, with some experimentation around image interpretation leading to its networks doing something that resembles artificial daydreaming – seeing shapes among clouds in a sky.

As with most futurist-bait on Twitter, the story immediately went viral, and also sparked counter-analysis. We hear a lot today about "smartness" and "intelligence" – highly elastic terms applied to a range of applications so wide that these adjectives approach meaninglessness. And yet, it's hard to deny that various forms of hard and soft machines are increasingly able to autonomously construct narratives that look and sound vaguely familiar to humans.

Scott Smith is founder of Changeist, a futures lab, He also lectures at IED Barcelona and the School of International Futures

Whether it's a cheeky Markov bot (disclaimer: I've been sharing one with colleagues as a pet for several months), an algorithm generating media art, or a learning experiment in a lab, machines are telling rudimentary stories of their own, albeit guided by human hands at the instruction level. Right now, bots make art they think is attractive (after human tastes), write simple stories for newspapers and wire services (playing something like complex Mad Libs, but with stock prices), and undertake dozens of other authorial tasks.

Hundreds of spambots weave crude narratives across social media every day, creating believable personas, tossing off crude *bon mots* and clunky aphorisms that aren't miles away from your average LinkedIn newsfeed. In creative terms, these weak intelligences are skittering across the uncanny valley, appearing human-legible enough that we read intent and sense into their works.

As with many areas of machine learning, the resolution of this creativity is refining itself by leaps and bounds. From wearable technologies to home sensors and online behaviour, CCTV captures and credit-card purchases, most of us leave a trail of data smog wherever we go – or if we go nowhere at all. Credit agencies have built distorted portraits of us for decades. Lately, they've been joined by dozens of companies' big data projects, building an understanding of what we read, how we drive, what we eat on Wednesday and how we have sex. Our data doppelgängers enjoy rich, if unrecognisable, lives without us.

Where do we go from here? If machine imaginations, and their ability to craft rich machinic fiction, carry on their development at pace, it's

>

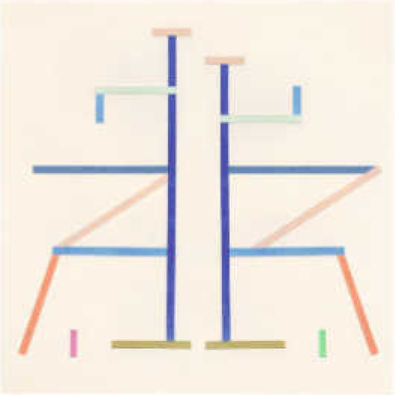
no doubt we will soon be consuming more non-human works. Who would know more about the drama of our daily lives than, say, a Roomba or Dropcam? Might a self-driving car write the next Kerouac-style novel? A crime procedural show as seen from surveillance cameras' points of view? One could imagine a bored smart-home staging a dramatic re-enactment from old log files while the family is away, replaying a family dinner through re-runs of lighting, air conditioning and appliance settings, like a domotic puppet show.

It may be hard for us to tell when this is happening. In effect, this evolution to machinic fiction has already begun. In the not-too-distant future, we'll see a popular media property mainly generated this way (to which a wag might reply: "How is that any different than the ratings-driven, over-tested pabulum we get now?"). The controversy over the first non-human Man Booker Prize or Turner Prize nominee will be notable, but short. Many of today's generation of art-school students already harness code to make art, or let the code make the art they contextualise. Why wouldn't this trickle down to popular media? And will we care? I doubt it.

Mark Earls is fellow of the Marketing Society and the RSA, an honorary fellow of the IPA and an ambassador at the School of Life

MARK EARLS

Be unoriginal. It's the creative way



Zaha Hadid is an architectural rock star. In recent years, her style has found full expression in London, Berlin, Singapore and 11 sites in China. So when she discovered that her showpiece Beijing development, Wangjing Soho, was being copied in another Chinese city before it was finished, Hadid redoubled her team's efforts to complete the project before the clone could see the light of day.

Zhang Xin, the billionaire property developer behind the Beijing project, reacted strongly to stop the copycat building. Hadid's response was strikingly different: if the copy were to solve certain architectural problems that Hadid had wrestled with, then "that could be quite exciting".

Here we have two attitudes towards copying: one that sees it as an infringement of intellectual property; another that sees it as potentially adding to the value of a project, by bringing something new.

These ways of thinking reflect two types of copying: copying tightly is machine-like replication; copying loosely creates error. Each has its place. Tight copying is essential when you need to maintain the integrity of what is being duplicated. Emergency-planning professionals get this. They spend ages teaching the human networks they have to rely on in an end-of-the-world scenario, to avoid creating variation in the information they pass along.

By contrast, loose copying embraces variation and error. The difference between the beaks of Darwin's finches were taken to be the result of error and variation passed down, amplified over several generations. In the creative world, loose copying is the essential mechanism for creating new work. As Grayson Perry puts it, "Originality is for those with very short memories." Why waste your time having a great idea that no one's had before, when there's all this material lying around ready to use? Shakespeare was a story thief – all but one of his plays have plots stolen from other writers. T. S. Eliot famously observed that it's not whether you copy but how you do it – that is the mark of a great poet. "Blurred Lines", the Robin Thicke/Pharrell Williams composition, does of course resemble Marvin Gaye's typical late-period groove. It was meant to. Film buffs would call this "homage" (though Quentin Tarantino delights in talking about theft).

The easiest way to create something new is to copy (loosely) and create error as you do so. One way of doing this is to copy from one context to another. When Ian Schrager ported what he knew from running the mega 70s nightclub Studio 54 into the hotel business, he created the boutique hotel. Another is to copy what works and fix what doesn't: while I was always told that James Watt "invented" the steam engine, it turns out he didn't. Watt copied the design from Newcomen that had been in widespread use in the mines of Britain for more than 50 years... and added an external condenser to improve the energy efficiency.

When professor Martin Elliott of Great Ormond Street Hospital looked to Ferrari's F1 team to help improve the survival rates of his tiny patients, he did both of these things and one more: he asked a different kind of question. Rather than seek to copy from medical practice, he realised that the underlying problem he was trying to solve was a handover one (both F1 driver and child patient are attached to a number of wires and tubes, each with a pump or monitor and a specialist expert to deliver them.) By understanding "What kind of thing?" he was trying to solve, he was able to scan the universe for things to copy (loosely).

Anthropologists have long drawn a useful distinction here between invention (the kind of once-in-a-blue-moon original idea that we all shoot for) and innovation (the result of repeated loosely copying). We – romantically creative fools that we are – use the latter when we mean the former. We imagine that somehow creativity and invention is not about copying, but about the muse or our own god-like genius. Flattering I know, but maybe all that is needed is some old-fashioned (loose) copying? If it's good enough for Shakespeare, Eliot, Hadid, Watt and the rest, isn't it good enough for you?

ILLUSTRATION: LIAM STEVENS

The founder kick-starting careers

IN THIS SERIES, INVESTEC PRIVATE BANKING EXPLORES THE PEOPLE AND STORIES BEHIND SOME OF THE UK'S MOST EXTRAORDINARY AND INNOVATIVE COMPANIES

In Dupsy Abiola's office:
1. Her barrister's court dress wig.
2. An African carving – a gift from her sister.
3. Abiola's father, pictured with Nelson Mandela.
4. 2013 Europa business award.
5. Her favourite Louboutins.

What do you do when you can't find the right entry level talent for jobs within a business? If you're Dupsy Abiola (*above*), you quit your position as a barrister and build a company to provide the solution.

"Intern Avenue solves a problem for two groups," says Abiola, its founder and CEO. "For employers, we allow them to very quickly identify the right high quality talent for their needs. And for candidates we suggest the best opportunities that are a good fit for their profile. Effectively, we're an online matchmaker."

Algorithms power this matchmaking platform, suggesting the right people for specific jobs and companies, based on employees' and employers' profiles. The company's backbone took two years to build, launching in 2012. It was a bold move, but tenacity runs in the family.

"My father used to say, 'whatever you do in life, try and make a difference – go out, be bold and do bold things,'" says Abiola. It's a mantra he lived by himself.

As a young man, Dupsy's Nigerian-born father, Moshood Kashimawo Olawale Abiola, was awarded a scholarship to study accountancy in the UK. From that foundation he built an impressive career, which included a global business, philanthropy and, later, politics. Despite being regarded as the winner in Nigeria's first free election in 1993, Moshood would never lead his country. Detained by Nigeria's military leadership, he died in prison in 1998.

Moshood's amazing life has inspired millions – including his own children.

"I'm lucky to have come from a family of high achievers. It's something to aspire to," says Dupsy. "A driving force."

Her mother was just as influential for the Abiola children, instilling in them the idea that education was a key enabler – the one thing that once gained, could never be taken away. It makes sense that Abiola would go on to start a company that helps young people make the most of their hard-earned education.

Many have applauded the cause. Intern Avenue won a Europa Award in 2013 for best recruitment startup and has been short-listed for several others. When Abiola spoke at 2014's Digitising Europe event, her startup was endorsed by German chancellor Angela Merkel.

Abiola isn't slowing down, either. The site has just had a major redesign and its new app will follow. European expansion is also planned. So, what's her secret?

"Stay positive," she says with a smile. "Take the things that seem like problems and turn them into opportunities."

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As a different type of private bank – one with a rich story that begins with our founders, Investec Private Banking celebrates fearless UK entrepreneurs like Dupsy Abiola. In partnership with our clients, we seek to write tomorrow's success stories, motivated by a shared drive to succeed and an entrepreneurial spirit. It's one of the many ways we live up to our promise to be out of the ordinary. Read our story and the stories of other *#FearlessFounders at investec.co.uk/privatebanking*

PHOTOGRAPHY: CHARLIE SURBEY

It's important to wash your outdoors clothes carefully, using optimal resources, so there's a specialist mode to keep them in top condition.

The iSensoric range includes a self-regulating system of smart sensors and intelligent internal software.

Confident in their performance, all Siemens washing machines are covered by a five-year parts and labour guarantee.

SIEMENS / WIRED PROMOTION

Intelligent washing

WHY SHOULD SHARP DESIGN AND CUTTING-EDGE TECH BE RESERVED FOR THE REST OF THE HOME, BUT NOT YOUR LAUNDRY ROOM?

The Siemens home appliances range of washing machines spell style from the start. A futuristic TFT or LED display, and a central control dial that glows blue, complement the perfectly round white and chrome porthole door.

It's not just looks these machines benefit from, they perform too. With sensor-controlled technology across the range, these washing machines can analyse your laundry load, automatically dose the correct amount of detergent and adjust the machine's cycle to reduce time, energy and water consumption – controlling every step of the washing process. This is Siemens iSensoric technology at work.

The good news? iSensoric technology is also available across Siemens dishwashing and cooling appliances. Your home is about to get a whole lot smarter. *Visit siemens-home.co.uk*

Auto-dosing
i-Dos is the automatic dosing system by Siemens. Simply load up with detergent and the machine automatically doses based on fabric type, weight of laundry and how dirty it is.

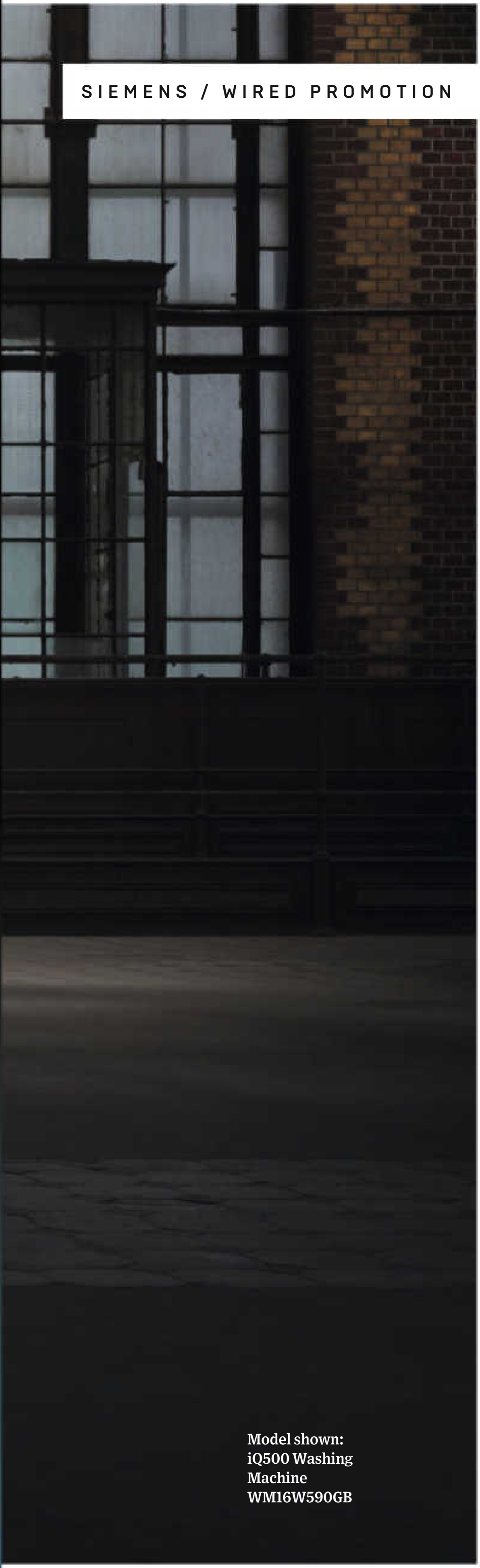
Five year guarantee
Confident in their performance, all Siemens washing machines are covered by a five-year parts and labour guarantee for added peace of mind while you wash.

Waterproofing
It's now possible to waterproof clothing using a washing machine. Siemens have added a programme to wash and waterproof at the same time, and recommend using Nikwax products.

Stain removal
The Siemens range of washing machine adapt each wash to remove the most common stains, so you no longer need to be an alchemist to get rid of spills and scuffs. Great for those with children.

Auto-programmes
The easiest way to do the laundry is to let the machine do it for you. Auto programmes use data from each sensor to steer the whole washing process with perfect results every time.

rapid15
Designed for hectic lives, this wash cycle will clean clothes in super swift time. rapid15 washes, rinses and spins laundry in just 15 minutes, perfect if that shirt needs cleaning half an hour before dinner.



Model shown:
iQ500 Washing Machine
WM16W590GB

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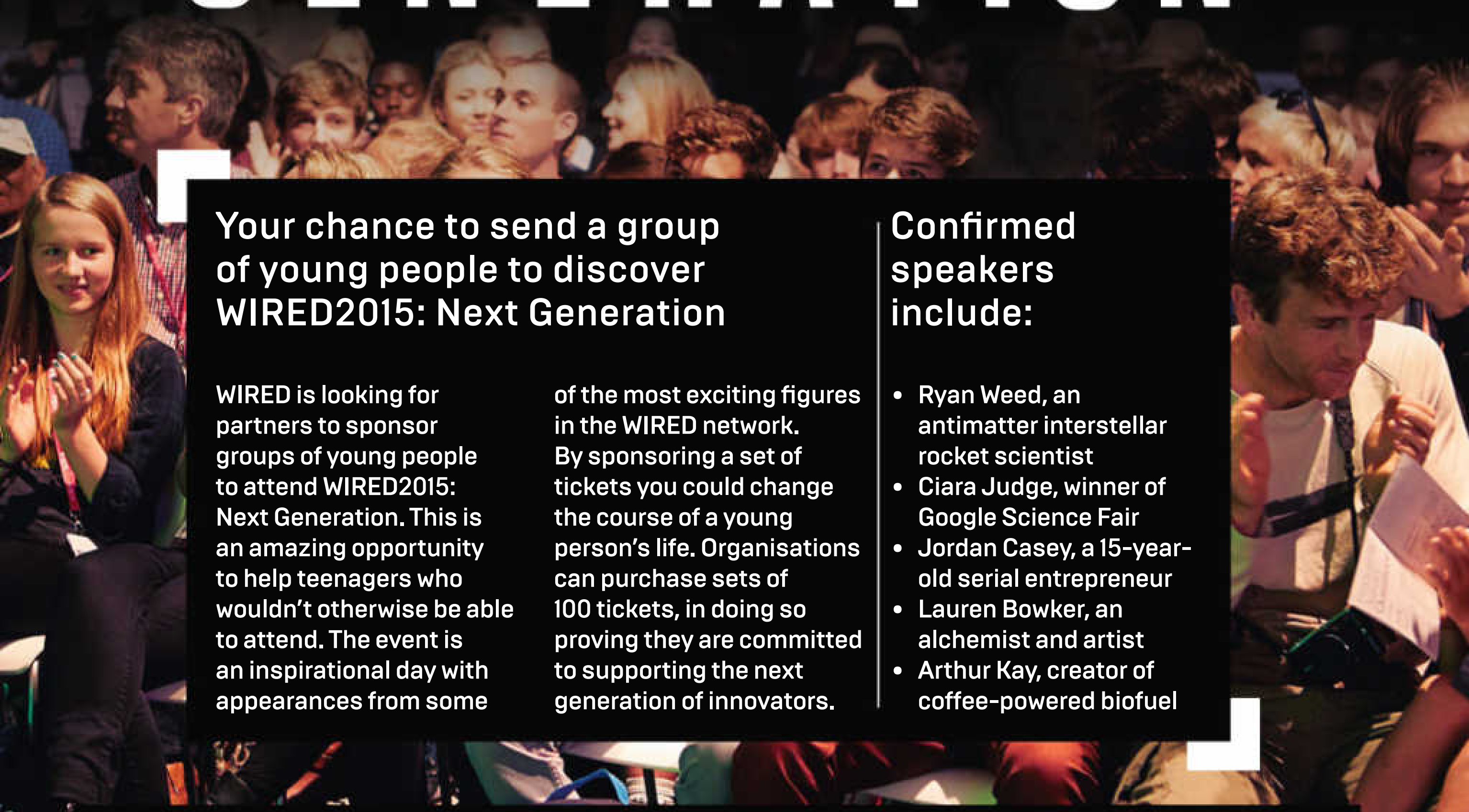

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- Ryan Weed, an antimatter interstellar rocket scientist
- Ciara Judge, winner of Google Science Fair
- Jordan Casey, a 15-year-old serial entrepreneur
- Lauren Bowker, an alchemist and artist
- Arthur Kay, creator of coffee-powered biofuel

FOR EVENT DETAILS VISIT WIRED.CO.UK/NEXTGEN

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WIRED Next Generation is open only to those aged 12 to 18.
Adults are welcome only with an accompanying teenager.

PLAY

THE JETMAN SPREADS HIS WINGS

Yves Rossy built his own jet pack. Now he wants to share it with the world >

To Yves Rossy, soaring 2,100 metres above the Dubai desert in a self-designed jet pack is child's play. "You know when you see kids in the garden pretending to fly? It's like that." But what else would Rossy say? The Swiss former fighter pilot – AKA Jetman – has been flying his self-designed jet pack since 2008. "It took 20 years to develop," he says. "It looks easy, but it wasn't."

Each of Rossy's flights starts with a plane jump. Using the 55kg carbon-fibre wing, powered by four small Jet-Cat P200 turbine engines and attached using a custom harness, he can hit up to 300kph. Since his debut, Rossy has racked up tens of millions of YouTube views. But recently he became frustrated with the craft's limitations. "There are still engine failures. Not enough power. We struggle with high heat," he says.

He will soon unveil a new wing. The centrepiece: improved Jet-Cat engines designed to be faster and more manoeuvrable. "We will have more power, more speed, the ability to go really high," he says. He has also worked with a parachute developer to create a low-altitude parachute for the wing, which will allow him to fly even closer to the crowds.

But Rossy won't be the Jetman forever – at 56, his age is catching up with him. So in May he introduced his protégé, French wingsuiting champion Vince Reffet, who is also helping him develop the new wing system. "The first time we flew, I was frustrated, as he is much better than me," says Rossy. Together, the two plan to develop a commercial gliding wing. The ultimate goal? Individual air transportation for all. "For sure, it will come," says Rossy, "it's just a question of energy." Until then, he'll keep pushing the limits. "This is like the beginning of aviation. It's the beginning of Flying Man." **OF-W** *jetman.com*

Digital extra!
Download the WIRED app to see a video of the Jetman in action

ART THAT MAKES YOU THE SUBJECT

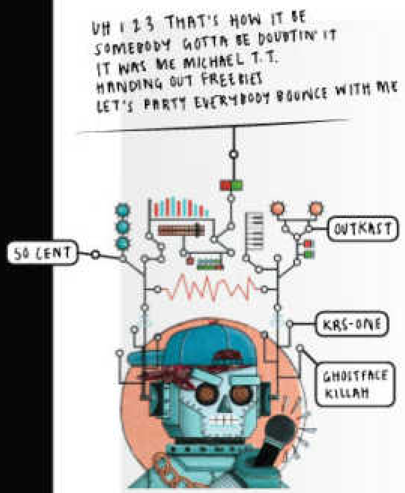
The first gallery dedicated to the next generation of interactive art is opening in London's Mayfair

PHOTOGRAPHY: MAX HAIM; HENRY COLLINGHAM. ILLUSTRATION: JACOB STEAD

Interactive artist Dominic Harris turns his audience into artworks. "I like to flip the role of the viewer into that of the performer," says the 38-year-old Londoner. "The art is in the delight that manifests when the viewer interacts with each piece." Take his *Vanity Mirror* (*pictured*), a mesmerising, kaleidoscopic wall of 180 LED screens and 180 embedded cameras inspired by the narcissism of the social-media age. "It's the selfie, magnified," he says. Harris's other works also play with sensory input, using touch and movement. "I'm always looking for new ways to elicit a response from the viewer," he says. In *Conductor*, the viewer stands in front of a vast solar system as haunting music plays. Their actions are tracked by 3D camera, influencing real-time changes in the music. *Stained Glass: Arboretum* uses transparent LED displays to recreate a traditional stained-glass window; the glass houses a plant that grows and changes in response to the viewer's gaze.

A trained architect, Harris founded a design practice, Cinimod Studio, in 2007, which creates installations for clients such as Microsoft and BMW. But he became frustrated with the industry's glacial pace. "As technology has advanced, art has stagnated," he says. "It's frustrating; if you go around Art Basel or other major fairs, there's very little innovation." His response: to help create PHOS ART + DESIGN, a gallery in London's Mayfair for interactive art. The space is built on a 500mm grid of panels which hides connectivity and power for audiovisual pieces, plus an eight-channel sound system. He will open it on September 18 with a solo show. "It's designed for the next generation of art," he says. **OF-W** *dominicharris.com*

Below: Dominic Harris using a Raspberry Pi in his Hammersmith studio to create *Vanity Mirror*


UH 1 2 3 THAT'S HOW IT BE
SOMEBODY GOTTA BE DOUBTIN' IT
IT WAS ME MICHAEL T. T.
HANDING OUT FREEBIES
LET'S PARTY EVERYBODY BOUNCE WITH ME
50 CENT
OUTKAST
KRS-ONE
GHOSTFACE KILLAH

RAPPER'S REWRITE

Eminem may be a (self-proclaimed) rap god, but DeepBeat is a rap bot. An algorithm developed by AI researchers at Aalto University in Finland, it can generate lyrics by mining a cache of 583,669 lines from 10,980 songs and combining them into new forms. "It was a challenge for it to detect rhymes, as English is not phonetic," says lead researcher Eric Malmi. "We gave it a phonetic transcript of the lyrics."

Malmi created models to teach DeepBeat how to pick the most relevant next line, by analysing structure and keywords. Its raps have 21 per cent more rhymes than the highest-ranked rapper Malmi spotted – Inspectah Deck.

But although the algorithm achieved great accuracy – it can tell a song's next line from a random one in 82 per cent of cases – its songs won't win Grammys. Malmi is focused on helping it write more coherent songs. "It could improve lyrics and rhymes, but building storylines will still be for artists," he says. "Short of a rap singularity, rappers won't be put out of business." **Gian Volpicelli** *mining4meaning.com*

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SERIALS AND SEX ROBOTS

Margaret Atwood tells WIRED about her new novel – and what tech is doing to storytelling

For an author who specialises in creating bleak futures – such as the totalitarian Christian regime of *The Handmaid's Tale* and the genetic pandemic of the *Oryx and Crake* trilogy – Margaret Atwood has an impish sense of humour. "I wrote a five-word novel for WIRED once," says Atwood (*pictured*). "It was, 'Wanted him. Got him. Shit.'"

Atwood's stories defy the sci-fi tag; she prefers to call them speculative fiction. "My books build on ideas and concepts that already exist," she says. Her new novel, *The Heart Goes Last*, is true to form: tapping into her knack for combining disturbingly realistic futures with dark comedy – in this case, a love story gone wrong in a lawless America. "My stories all have a comic twist," she says, "but they wouldn't be as funny if they were real." Here, the 75-year-old literary giant talks about sex robots, comics and the future of books. **Madhumita Venkataramanan** The Heart Goes Last *is published on September 24*

PHOTOGRAPHY: JEAN MALEK

Margaret Atwood: "I'd say that I've explored technologies, not embraced them"

WIRED: You often write about real scientific concepts. Which topics fascinate you now?
Margaret Atwood: In the new book it's sex robotics. Those are making great strides. They do really have ones with warm body temperature in Japan and there's a creepy site with a video that has a robot girl saying things like, "touch me, touch me now". They're a bit like Barbies, the ones that can talk. Even back in the 50s there was a doll called Chatty Cathy. So this is the advanced version of those.

***The Heart Goes Last* started out as a digital serial for storytelling platform Byliner. How did you find writing for that form versus a novel?**
It's a lot of pressure; you have to write very quickly. I did four stories over eight months. But I don't change my style or what I write. When I turned it into a novel I had to remove repetition, which you need when you're writing in serial form, because you have to remind readers what happened. Dickens wrote in serial form. That's why the pacing is the way it is – each chapter ends on a cliffhanger.

Did you find having real-time feedback from readers during the writing process useful?
I got a lot of feedback, but it didn't impact the final novel in any way. You see the same with [George RR Martin's] *Game of Thrones*. No one knows the end, not even the writers of the TV show, because he hasn't published the last book yet.

You've embraced social media more than many authors. How did you get started?
I'd say I've explored technologies, not embraced them. Embracing means you love every minute. I try them out to see how they might work for me as a writer. Pinterest is good for people in visual arts, design decoration and so on, but for a writer there's no point. It started when I built a website for the launch of *The Year of the Flood*, which I had never done before. Back in 2009, the publicity team said, "You should have a Twitter feed. It's really easy, we'll show you." So I started on Twitter. >

A lot of authors – especially women – have seen and experienced social media used for harassment.
Twitter has given harassment a larger platform. For vulnerable people it can be devastating. The equivalent in Agatha Christie murder mysteries is the poison pen letter. I think Mary Beard deals with it well – she confronts these people publicly. And, yes, I think it's worse for women online. It's part of an old tradition of misogyny, but more for young women because they are objects of desire. Once you get to the granny stage, which I'm at, it happens a lot less.

Aside from writing, you also invented a remote-signing device, the LongPen, and spun out a company based on it. Have you always been entrepreneurial?
I grew up in the woods, so you had to improvise. I knew about machines before they were digital. I could fix my own outdoor motor, take apart my sewing machine and put it back together. Entrepreneurial is what writers had to be in Canada in the 60s – the book tour and the reading events were invented in the 70s and 80s. Things are invented when the need arises. LongPen came out of that; this was before e-books, tablets and the iPhone – it started in 2004. We thought it would be great for a writer to be virtually present. Now the business has evolved. It's remote signatures for things like banking.

> 'THERE ARE TWO VERSIONS OF THE FUTURE THAT COULD EXIST — GOOD AND BAD'

You recently wrote a novel for the Future Library project, which won't be published for 100 years. What do you think the world will look like then?
There're two versions of the future that could exist – the good version and the bad. By writing and storing something for 100 years, you're gambling on the good version of the future – that humans will still be alive and able to read, that there will people who will care about reading, that the Oslo Library will have survived.

What's the worst that could happen?
I'm not personally scared of anything. I'm too old. But for the human race, they have to keep an eye on the oceans. They are being poisoned. The problem is we are pouring so much crapola into the ocean.

You've written novels, poetry, plays, a film – are you interested in experimenting with other media?
I'm of the comic-book generation – we went to the Saturday matinees, which were frequently serials like *Superman* and *The Lone Ranger*. I drew comics as a child and as a teenager and just recently did one called the *BookTour Comix* as a Christmas present to my publishers. Apps such as *Periscope* offer authenticity. We did the Future Library launch with *Periscope* in a forest with no Wi-Fi. I have also made a YouTube video. Google "Rick Mercer goalie". It took us five hours!

Is technology changing how you read?
I find reading on tablet is good for short things. It's hard to read a long novel on screen. But digital is searchable; you could search for every mention of the word "prestidigitation" in a novel. Publishers used to think if people read things online they wouldn't read it again on paper but that's wrong. There have always been many formats and payment models. For instance, Sherlock Holmes began as a magazine story. Dickens, as I said, wrote serials. There was once a vogue for three-volume novels. Books have never been just one thing.

LEGO'S NEXT BIG MASH-UP

Every tie-in is awesome in the toy franchise's new platform

What do Scooby Doo, Doctor Who and Gandalf have in common? They've all been recreated in LEGO. But whereas kids have long been free to create mad, inter-genre mashups, boring grown-up property rights meant that LEGO video games were unable to join in the fun – until now. *LEGO Dimensions*, out on September 29, combines the toy franchise's many tie-ins in one place – while also merging the physical toys with the digital world for the first time.

"*The LEGO Movie* was a fantastic door opener for this huge shared LEGO universe," says Mark Warburton, producer at Cheshire-based developer TT Games. In *Dimensions*, players use the Toy Pad, an NFC-connected peripheral, and LEGO figurines to connect their physical toys to the game. Although such mechanics aren't new (*Skylanders* and *Disney Infinity* have spawned an entire toys-to-life genre), *Dimensions* uses the bricks to introduce new possibilities. "One minute they will be moving the toys around to teleport through the levels, and the next they will be using it to enlarge or shrink their characters," says Warburton. At certain points, players are required to rebuild their bricks according to instructions on screen – further blurring the line between physical and virtual worlds.

The studio had to create a story that would believably combine so many characters, so they wrote a plot involving a mysterious villain who breaks the barriers between the various franchise "worlds". "It was brilliantly written so it can bend and shape as much or as little as we want," he says. "Who would have imagined Chell [from *Portal*] interacting with Doctor Who and Homer Simpson? It's a real joy to be able to play with these characters. It's the game we all grew up wanting." **OF-W** *lego.com/dimensions*

ILLUSTRATION: LAURINDO FELICIANO

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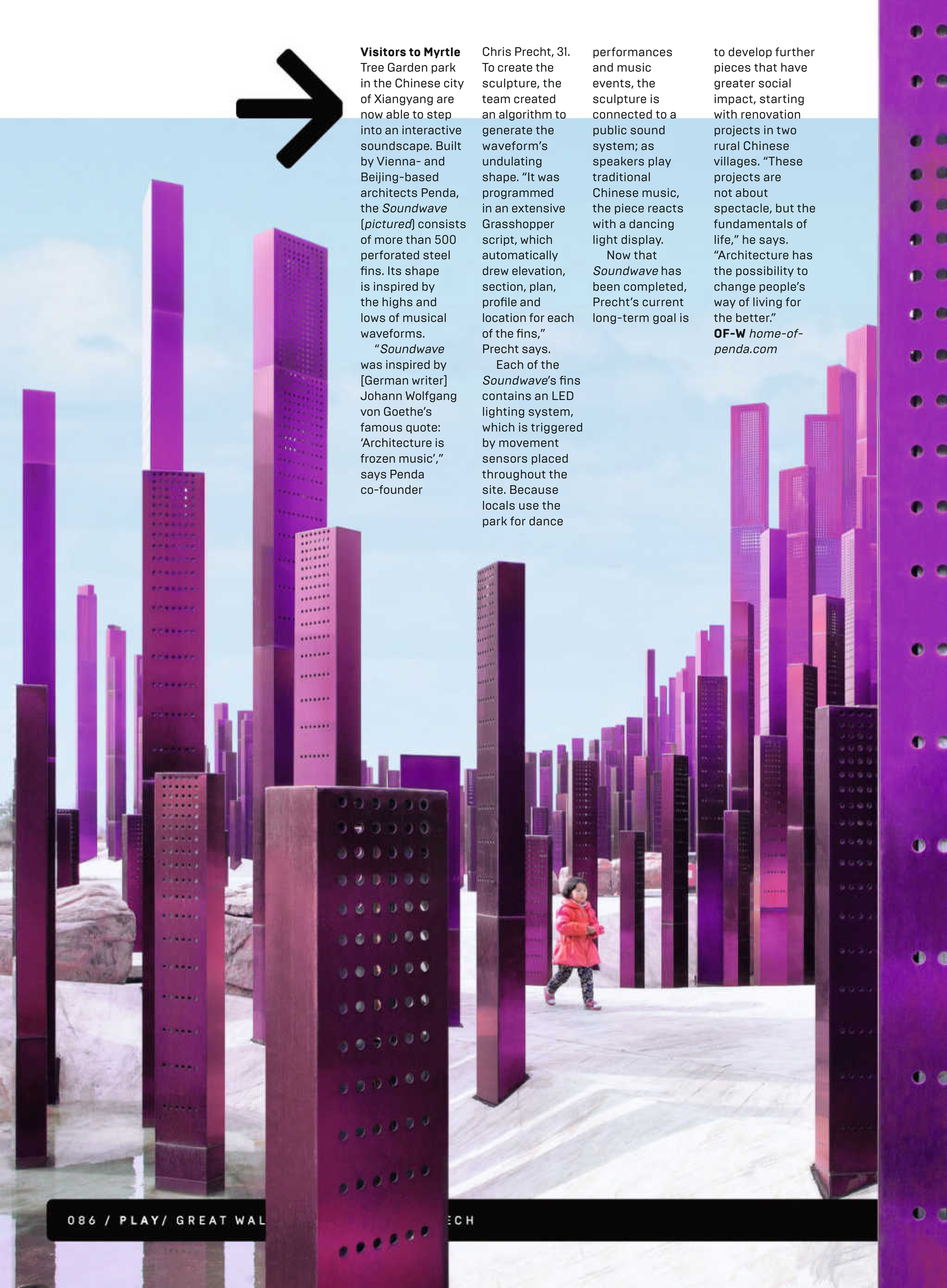
Helmet from the ship burial at Sutton Hoo. Anglo-Saxon, early 7th century AD. From Mound 1, Sutton Hoo, Suffolk, England.



Visitors to Myrtle Tree Garden park in the Chinese city of Xiangyang are now able to step into an interactive soundscape. Built by Vienna- and Beijing-based architects Penda, the *Soundwave* (*pictured*) consists of more than 500 perforated steel fins. Its shape is inspired by the highs and lows of musical waveforms.

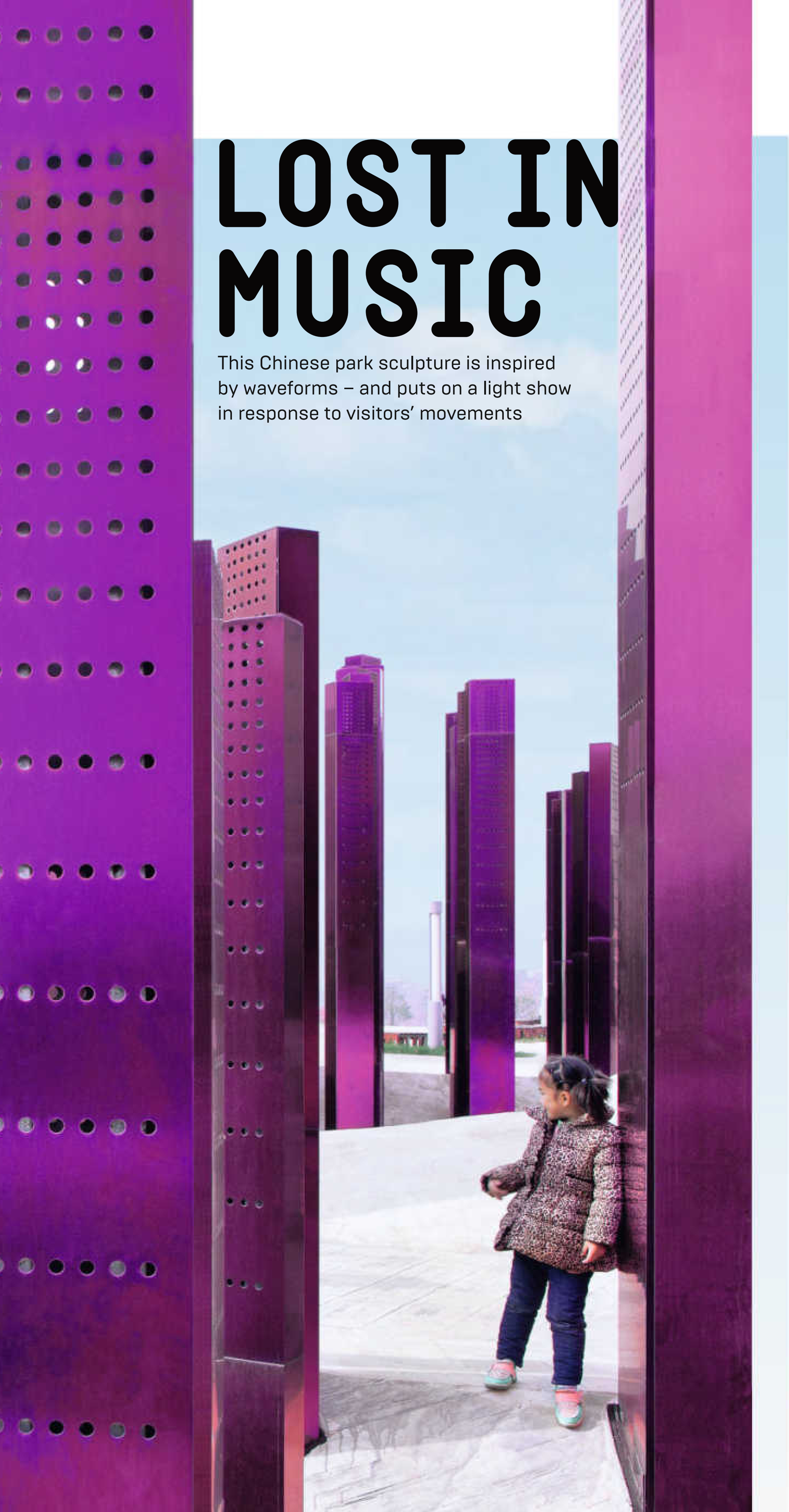
"*Soundwave* was inspired by [German writer] Johann Wolfgang von Goethe's famous quote: 'Architecture is frozen music'," says Penda co-founder Chris Precht, 31. To create the sculpture, the team created an algorithm to generate the waveform's undulating shape. "It was programmed in an extensive Grasshopper script, which automatically drew elevation, section, plan, profile and location for each of the fins," Precht says.

Each of the *Soundwave*'s fins contains an LED lighting system, which is triggered by movement sensors placed throughout the site. Because locals use the park for dance performances and music events, the sculpture is connected to a public sound system; as speakers play traditional Chinese music, the piece reacts with a dancing light display.

Now that *Soundwave* has been completed, Precht's current long-term goal is to develop further pieces that have greater social impact, starting with renovation projects in two rural Chinese villages. "These projects are not about spectacle, but the fundamentals of life," he says. "Architecture has the possibility to change people's way of living for the better." **OF-W** *home-of-penda.com*

LOST IN MUSIC

This Chinese park sculpture is inspired by waveforms – and puts on a light show in response to visitors' movements



BUILD A BEDTIME STORY

Lost My Name is helping kids learn to read – with data. The London-based startup creates personalised children's books: enter a name into its web tool and it generates a story. Its first book, *The Boy [Or Girl] Who Lost His/Her Name*, has sold more than 600,000 copies. "Personalised books have been on the market for more than 40 years, but have never been taken seriously," says Lost My Name co-founder Asi Sharabi, 41.

Sharabi and co-founders Tal Oron, writer David Cadji-Newby and illustrator Pedro Serapicos set out to help children learn their name by making the letters in them into characters. To create a database of names, Sharabi consulted the UK Census. Lost My Name now has 1,000 illustrations in seven languages, and in June secured $9 million (£5.7m) in funding led by Google Ventures.

Its next book, *The Incredible Intergalactic Journey Home*, out in September, teaches kids about places – with the help of generated galaxies, Nasa images and GPS data. "We're interested in combining the power of stories with technology to create magical experiences," says Sharabi. "Books have been neglected as a medium for innovation – we're changing that." **OF-W** *lostmy.name*

ARTISTS WE'VE PUT MONEY ON

Meet the three WIRED/The Space Creative Fellows being awarded £100,000 to fund new works

THE WIRED FELLOWS
2015

WIRED has long chronicled the intersection of art and innovation. This year, we've partnered with digital-arts organisation The Space to create the WIRED/The Space Creative Fellowships. The winners, chosen from hundreds of applicants by a panel of judges (*see below*), will be granted a total of £100,000 by The Space to produce three new projects with the potential to impact the wider world, while also pushing the boundaries of art. Here are this year's winners, who will present their projects at WIRED2015 on October 15-16. OF-W

THE JUDGES	**Ruth Mackenzie** Launch director **The Space**	**Olafur Eliasson** Internationally acclaimed artist	**David Rowan** Editor **WIRED**	See more at WIRED2015 wired.co.uk/15

ALISON KILLING

Founder,
Killing Architects
The Netherlands

Urban designer Killing, 35, is working on *Migration Watch*, a digital installation that uses real-world data and mapping to follow a group of migrants on their journey from the Middle East and Africa to Europe. "It will be a reconstruction, but presented as something that's happening live," she says. "I want to bring the audience on the journey, to share the hopes, suspense and panic of the migrants."

An architect by training, Killing has long held a fascination with death. (However, her surname, she says, is a coincidence rather than nominative determinism.) *Death in Venice*, her most recent project, which incorporates interactive maps, projections and photography, explores how the architecture of hospitals and hospices relate to death, and how this relates to modern society and attitudes.

Killing founded her architecture and urbanism research studio, Killing Architects, in 2010. Although she plays down notions of a "smart city" revolution, she does believe technology can change the way we think about urban design. "Architecture is an interesting position from which to consider a range of social, economic and political issues," she says. "These things shape our buildings and cities, but the reverse is also true."

James Temperton
killingarchitects.com

LAURA KRIEFMAN
Choreographer
Crane Dance,
Bristol

Choreographer Laura Kriefman's Guerilla Dance Project studio specialises in fusing movement and technology. Her latest project? Taking over a city skyline. "*Crane Dance* will be a synchronised dance routine across a city, using all the construction cranes," says 32-year-old Kriefman. "Cranes really demonstrate our disconnection from our cities. It's about taking back possession of our spaces."

The plan is to hold *Crane Dance* in London in spring 2016; before that, a rehearsal is planned to take place in Bristol this October. "The WIRED Creative Fellowship is an amazing validation of all our hard work," she says. "And I get to drive a crane." **OF-W**
guerilladance project.com

ANNETTE MEES
Director,
The Human Project,
London

In *The Human Project*, Mees will create "change labs" on six continents, in which 15- and 65-year-olds, supported by a network of artists, thinkers and activists, will create an "almanac of the future". The project will propose changes to society for the next 50 years.

As co-director of immersive stage company Coney, Mees creates theatre that collaborates with its audience. But *The Human Project* is a new challenge: "How do we feel empowered to think about creating our future when there are so many agendas?"

Mees wants the project to have "a relentless optimism to it". "This is all about the future we want," she says. **Katie Collins**
coneyhq.org

ILLUSTRATION: JOE CRUZ

PRINT A CAR, SAVE THE WORLD

This supercar was built with a 3D printer. The Blade, a prototype two-seater coupé created by San Francisco-based Divergent Microfactories, contains a chassis assembled from carbon fibre and 3D-printed aluminium parts. At 630kg, it has a third of the weight of a factory-made car. The result: a 700hp monster capable, its maker claims, of hitting 0 to 100kph in two seconds. And it's designed to green the planet.

"We wanted it to be super-efficient, so we made it very aerodynamic," says Divergent CEO Kevin Czinger, 51. Having built hot-rods as a child, Czinger previously founded an electric-car startup, Coda Automotive. Coda's car failed, but Czinger became convinced that swapping petrol for batteries isn't the only solution for reducing climate change. "Manufacturing-based pollution is much worse than pollution from tailpipe exhaust fumes," he says. "And over the next 40 years we are going to build billions more cars."

The 3D-printed joints that hold together the bodywork's carbon-fibre tubes allow the chassis to be assembled at speed, without the need for a traditional plant. "In five years we could probably take the total manufacturing costs well below $2,000 [£1,300] per chassis," Czinger says. Divergent isn't the only automotive company using 3D printing: Arizona-based Local Motors has also debuted a vehicle using the technique, and others are exploring printing replacement parts.

Divergent is now making the Blade's underlying design model available to small car companies. This, Czinger says, could help to bring about a sea change in an industry dominated by huge corporations with giant development budgets and slow production schedules. "The plan is to take the $1 billion factory and turn it into a $20 million plant for smaller, creative teams," he says. "We're democratising the car sector." **GV**
divergentmicrofactories.com

Divergent claims that the 630kg Blade's chassis takes less than 30 minutes to assemble by hand

FILMING IN THE FREEZER

When Baltasar Kormákur decided to make *Everest*, he knew he had to shoot there – and that the experience would test his team's limits. "When you're going from Camp 4 to the top and back, the body starts falling apart," says the Icelandic director. "It's a slow death. If you're up there for more than 12 hours, you won't make it down."

Out this month, *Everest* is a mammoth, IMAX-sized dramatisation of the 1996 blizzard that killed eight climbers. Kormákur wanted to honour the dead with authenticity. So in January 2014, he took the cast, crew and equipment to base camp, filming at altitudes higher than 5,400m. "I probably would have shot with the actors on top of Everest if they'd have let me," he says. "But I wouldn't be here now." After Nepal, they moved to Italy to shoot in the Dolomites which, at -30°C, were no less forgiving. "We were filming with Jake Gyllenhaal and he was frozen to the bone," Kormákur says. "I pushed him until he couldn't take it. His face was frozen and his nose was icy."

Finally, the team relocated to Pinewood Studios in Buckinghamshire. "We built a huge see-through box, cooled the air in it to below zero, and imported snow from the Netherlands to blow into actors' faces," he says. "It's not an easy watch. I really want the audience to feel it." **Alex Godfrey** Everest *is out on September 18*

FASHIONED FOR THE RED PLANET

How The Martian's costume designer consulted Nasa to build a suit fit for Mars

When you're making a blockbuster film that's set on Mars, there's a lot of science to get wrong. But for *The Martian*, a cinema adaptation of Andy Weir's self-published bestseller about a lone astronaut stranded on the red planet, director Ridley Scott partnered with Nasa to ensure the film was as realistic as possible.

"The story is set only 14 years in the future, so I thought we'd start with Nasa's concepts," says Janty Yates, the film's Oscar-winning British costume designer. To design the suit worn by protagonist Mark Watney (played by Matt Damon, *pictured*), Yates went to the Jet Propulsion Laboratory, and consulted the Smithsonian's spacesuits curator. But Nasa's designs created a problem: "The Z1 is a Buzz Lightyear lookalike, and the Z2 looks far too futuristic for us," she says. So she decided to create something more cinematic.

A suit worn on Mars would need to be sealed. However, Yates's is as breathable as possible, for the sake of the actors on baking hot 14-hour shoots in Jordan and Hungary. The suit's Portable Life Support System – which real-world astronauts use to process filtered air – instead houses high-capacity batteries. These power both a series of hidden fans that bring outside air in, and the helmet's internal LED lighting, which can be remotely controlled from up to 2km away. The suit's hoses connect to an internal cooling system, and a camera was mounted on the backpack's side.

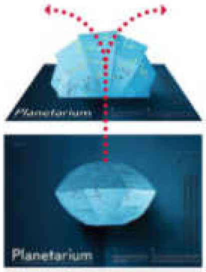
Despite all this added tech, the suit is more comfortable than the real thing (for instance, the boots are removable). This spacesuit might not survive a real dust storm on the fourth rock from the Sun, but it helped the actors survive the arduous conditions of a film set. And, Nasa, the next time you need some new outfits, you know who to ask. **Liat Clark** The Martian *is out on September 30*

1. The mirrored gold Sun visor has dimmable lights on the edge to light the face

2. Compartments in the hard upper torso house sound equipment and transmitters

3. Twenty-three plates allow heat to dissipate. 3D spacer fabric sits between them

PHOTOGRAPHY: KURT ISWARIENKO; ALAMY. ILLUSTRATION” NATE KITCH



A POP-UP BOOK WITH A DIFFERENCE

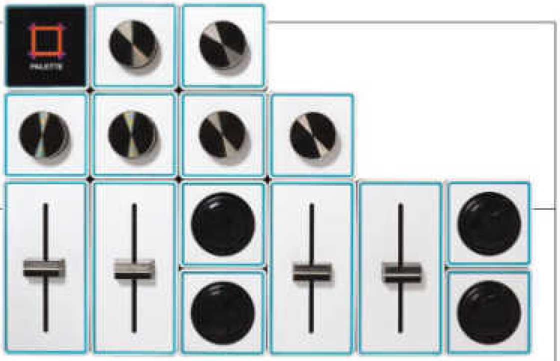
Kelli Anderson wants paper to teach us about the world. The Brooklyn-based artist’s *This Book is a Planetarium* is a publication with a twist: its pages morph into a planetarium, an amplifier and even a (functioning) guitar.

For Anderson, 33, these paper contraptions are more than origami. “There’s a lot of info we know second-hand,” she says. “We know that sound is caused by vibration. In my book there’s a contraption you can amplify the sound with, and you can actually experience it first-hand. It’s about being able to touch and do things you have been told about.”

Anderson has also used paper to explore the human body, create a forest featured in a stop-motion video, and build a record player. It took her a year to design the book’s six mechanisms, some of which were particularly challenging. “The guitar was hard: the elasticity of the strings made the book close,” she says. Anderson is already working on more pop-up paper creations. “I came up with about 20 ideas,” she says. “I didn’t want to make the book too thick.” WIRED has never felt so one-dimensional. **Gian Volpicelli** This Book is a Planetarium *is out on October 6 kellianderson.com*

▶ DESKTOP DJ

Ever wished that your computer was more like a DJ set-up? Like LEGO bricks, Palette's dials, toggles and sliders can be combined and their functions customised to your needs. Ideal for Photoshop pros. *palettegear.com*



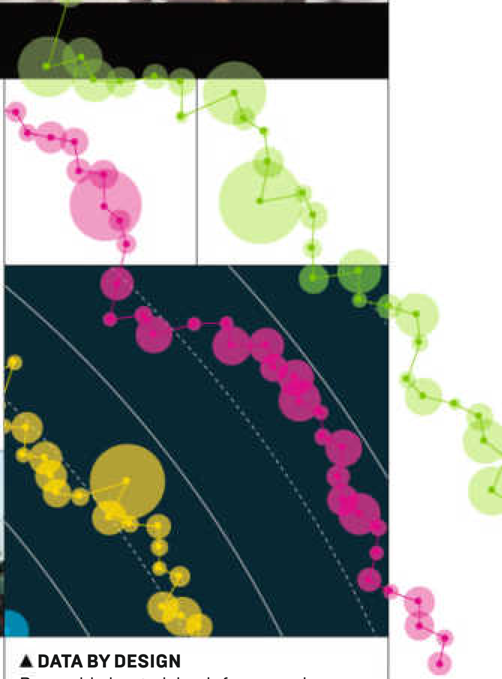
PLAYLIST

◀ WATER, WATER EVERYWHERE

Renowned German aerial photographer Bernhard Edmaier's shots are like geological studies. After last year's stunning *Earth*, Edmaier turn his lens to H_2O in all its glory in *Water*, from Venetian bays to glaciers. Refreshing. *randomhouse.de/prestel_eng*

▲ BATTLING BACK

Four years after the superb *Gloss Drop*, Battles are back with a new album *La Di Da Di*, featuring edible-looking artwork and a web-themed tracklist ("Dot Com"; "Dot Net" – but no "Dot IO"?). Expect the unexpected. *Out September 18 bttls.com*



▼ CHINA'S MOST WANTED

In Ai Weiwei's first full exhibition in the UK, the Chinese dissident takes on Beijing's snooping and poor free-speech record. Among the exhibits: marble cameras, Ming-style – the weight of surveillance. *From September 19 royalacademy.org.uk*

▶ THE PHANTOM MENACE

The latest in the stealth franchise, *Metal Gear Solid V: The Phantom Pain*, has Big Boss back in Afghanistan. All new: a real-time day-night cycle and full-motion capture, including Kiefer Sutherland. *Out September 1 konami.jp*

▲ DATA BY DESIGN

Paranoid about giving info away when you Google, tweet or swipe? *private i* by Signal + Noise – part of The London Design Festival – asks who *really* owns our data. You won't like the answer. *From September 25 londondesignfestival.com*

▶ VLOGGING THE APOCALYPSE

Sky's new end-of-the-world drama *You, Me & The Apocalypse* is set in a world doomed by a meteor. Produced by YouTube film-makers Bigballs Films, it features a variety of cameos from social-media stars. *On Sky One this month*

PHOTOGRAPHY: GRANT CORNETT

Goodyear hack

IN JULY, GOODYEAR UK INTRODUCED A TEAM OF YOUNG HACKERS TO A GROUP OF SCHOOL PUPILS, TO SPARK INNOVATION AND FIND NEW WAYS TO ENGAGE PRE-DRIVERS IN SAFETY ON THE ROAD

The Goodyear hackathon got a team of teenage coders to join a group of school pupils, aged 11-14, to compete in a special challenge. Their goal: to develop an idea for a game or app that appeals to young pre-drivers and improves their road sense.

The idea behind the London-based day was to give young people the chance to think of new, innovative and engaging ways of attracting their peers to pre-driver education. And to help develop a better approach to young-driver learning for the future – using their coding and programming expertise.

The winning idea, developed by Benedict Allen and Lawrence Berry, was *Gold Dash*. Based on Google Maps, the game teaches users the Highway Code by breaking the rules down into manageable skills and introducing new ones as play advances. Players need to understand each one, and use them in combination, to go out into the world – as shown by Google Maps – and collect gold.

The game can be played on a smartphone while navigating. It is designed to encourage users to play for regular bursts of up to 15 minutes several times a day – and return to check their gold and combine new skills.

The group's winning concept impressed Goodyear UK so much, the tyre company is now looking into ways to develop the app for release in 2016.

The hackathon formed part of the Goodyear Driving Academy programme, which serves to increase road safety knowledge at an earlier age and educate pre-drivers about the importance of road safety, with the view to creating better informed drivers in the future. *Visit youngdriverhack.co.uk*

ONE DAY. TENS OF IDEAS

"Gaming is the perfect way to make sure young pre-drivers get the right messages about driver safety at an early stage," says Kate Rock from Goodyear UK. "We were blown away by just how engaged the young coders and children were in the process, and by the fantastic ideas that came out of the hackathon."

PHOTOGRAPHY: LEON CSERNOHLAVEK

WIRED 2015

October 15-16, 2015
Tobacco Dock, London

For more information and to book your ticket now:
wired.co.uk/15
ⓘ wiredevents
#wired2015

Our two-day flagship conference is back, featuring the most exciting minds from across the WIRED world. Enjoy more than 50 talks, world-class networking and the Test Lab exhibition

The 13 WIRED Fellows speaking on stage include:

Claudio Sassaki
Education innovator
Sassaki is re-inventing education for millions in South America with his adaptive learning platform.

Alisée de Tonnac
Startup seeker
Tonnac is searching for startups in more than 50 countries through her international startup competition, Seedstars World.

Freeman Osonuga
Front-line ebola doctor
Osonuga worked in Sierra Leone for six months as a medical doctor taking on the ebola epidemic in Sierra Leone.

Arunima Sinha
Mountaineering amputee
Since losing her left leg below the knee, Sinha has scaled Everest, Kilimanjaro, Elbrus and Kosciuszko.

Arthur Kay
Creator of coffee-powered bio-fuel
Kay's bio-bean has industrialised the process of turning waste coffee grounds into advanced biofuels.

Fredrika Gullfot
Algae cultivator
Gullfot's Simris is growing algae that produce omega-3, to reduce dependence on fish and the depletion of endangered stocks.

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The 50+ Main Stage speakers include:

Vincent Connare
Comic Sans designer
Designer Connare explains what happens when you create the world's most controversial typeface.

Martha Lane Fox
Cross-bench peer and serial entrepreneur
Lane Fox chairs digital skills charity Go ON UK and leads the Open University as Chancellor.

René Redzepi
World-renowned food designer
Redzepi founded Noma, one of the world's best restaurants. He will lead a session on re-inventing food.

Hyeonseo Lee
North Korean defector
Hyeonseo escaped North Korea in 1997. Now living in South Korea, she has become an activist for refugees.

Frank Pearl
Colombian peace negotiator
Pearl took on the task of re-integrating former Revolutionary Armed Forces guerrillas into Columbian society.

Sophie Scott
Neuroscience innovator
Scott combines her research on the neuroscience of human speech with comedy as a "stand-up scientist".

Andras Forgacs
Creating lab-grown meat
Forgacs's company Modern Meadow is producing meat and leather in the lab – without harming animals.

Stephane Kurgan
Building hit games at King.com
Kurgan's company develops some of the world's most popular games and apps, including *Candy Crush Saga*.

| NEXT GEN | RETAIL

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WIRED INSIDER

Events, new products and promotions to live the WIRED life

Compiled by Cleo McGee

1 2

3 4

1/Farfetch Curates Design coffee-table book

Farfetch Curates Design is the second of three books exploring the finest creations of 2015. The book covers home interiors, furniture and objects, plus radical architectural projects and modern hotel makeovers in converted buildings. A thought-provoking and stylish read.
£16
farfetch.com

2/Public School x Tumi Collaboration wheeled bag

The urban NYC label Public School has teamed up with Tumi to create a six-piece collection fusing quality design with hard-wearing, technical innovation. This 53cm carry-on wheeled bag with combination lock, is made from Tumi's Tegris material in black graphite, with a laser-cut net overlay.
£795
uk.tumi.com

3/Chanel Le Lift skincare range

Chanel has expanded its Le Lift anti-ageing line. Inspired by epigenetics, the products claim to reduce the appearance of wrinkles by boosting production of youthful skin proteins. Chanel scientists have harnessed and enhanced a patented molecule from the edulis plant to achieve this.
From £60 to £130
chanel.com

4/Aramis Black men's fragrance

The slick Aramis Black bottle is a modernisation of the Aramis flacon – around since the brand was founded in 1964. White incense, tonka beans and vetiver grass create a fresh signature scent – it might even be an antidote to the end-of-summer blues.
£29 (30ml)
At high street retailers

WIRED INSIDER'S PICK OF UPCOMING EVENTS

WIRED 2015

Our two-day event returns with 50+ speakers, including 15 Innovation and Creative Fellows – such as startup seeker Alisée de Tonnac, and Laura Kriefman, an "augmented" dance specialist. The event also features the hands-on Test Lab product zone.
October 15-16, 2015
wired.co.uk/15

WIRED2015: NEXT GENERATION

Aimed at 12- to 18-year-olds and their parents, Next Gen merges hands-on workshops and short talks with performance. Meet RoboThespian – a joke-cracking, singing robot – and Jordan Casey, a self-taught programmer who founded three firms by the age of 15. *October 17, 2015*
wired.co.uk/nextgen

WIRED RETAIL

From smart shop-floors to VR to satellite mapping, WIRED Retail will explore the diverse influences impacting our future retail experience. At the St Pancras Renaissance Hotel, the event will host 20 Main Stage speakers, plus 15 exciting startups.
November 19, 2015
wired.co.uk/retail

LOUIS VUITTON SERIES 3

A combination of fashion and digital experience, this event showcases the past, present and future of the Louis Vuitton brand, as a series of rooms immerses the viewer in the story of the new collection.
180 The Strand, London WC2R 1EA, September 20-October 18, 2015. Tickets £50 from eventbrite.co.uk

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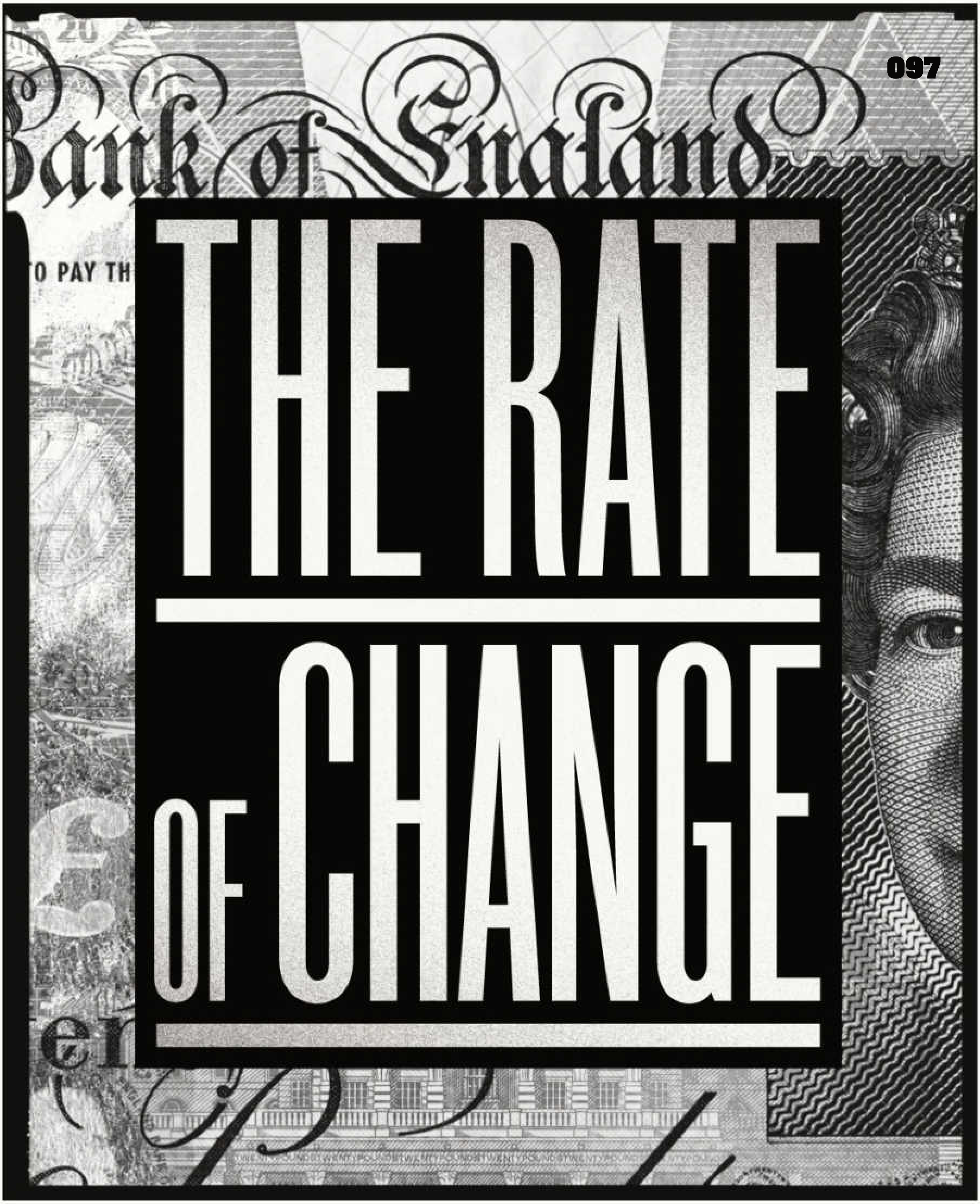
PHOTOGRAPHY: SUN LEE



THE RATE OF CHANGE

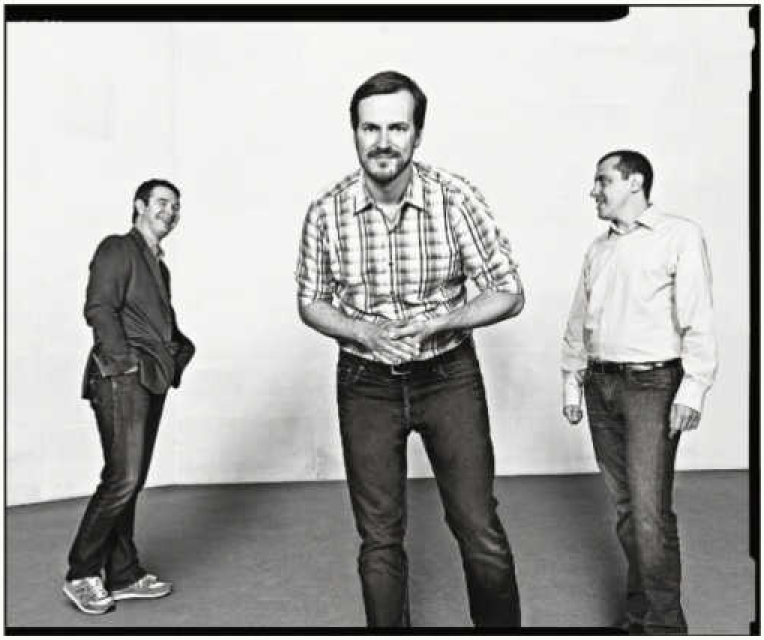
EIGHT THINGS WE LEARNED ABOUT THE FUTURE OF FINANCE AT WIRED MONEY 2015

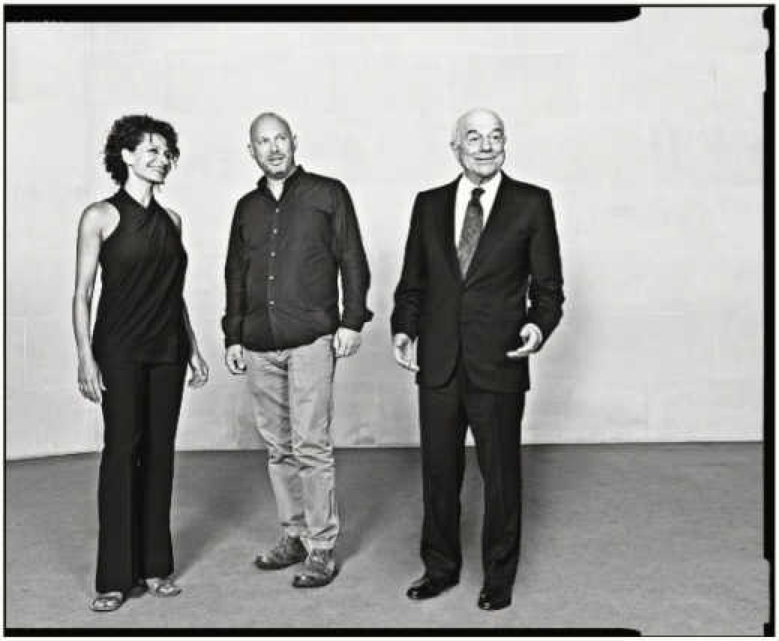
Edited by **Greg Williams** *Written by* **Stephen Armstrong**
Photography: **Charlie Surbey**

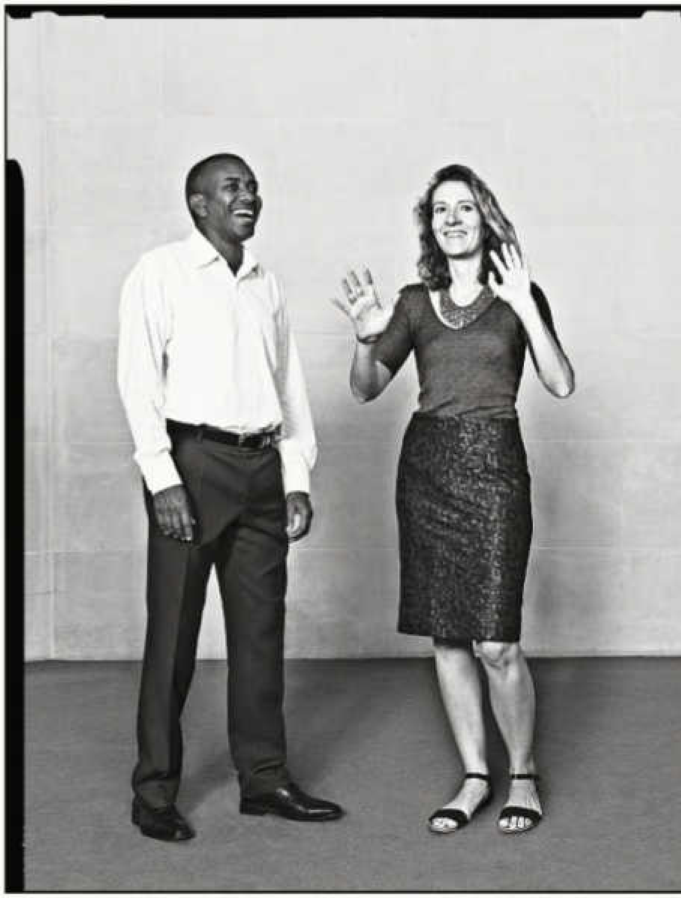
ADDITIONAL PHOTOGRAPHY: DAVID LIDWELL

MEET THE SPEAKERS

You may not have been able to attend our third annual WIRED Money event, held at the British Museum on July 8, but we wouldn't want you to miss the key insights and inspiration from almost 40 entrepreneurs, incumbents, startups, activists and evangelists who spoke from our two stages. Here's our guide to WIRED Money 2015, Together With BBVA. Studying these pages would be a wise investment... David Rowan







This page, clockwise from top left:
Shivani Siroya CEO and founder, InVenture; **Samir Desai** CEO and co-founder, Funding Circle; **Peter Smith** CEO and co-founder, Blockchain ◆ **Brian Forde** director of digital currency, MIT Media Lab; **Taavet Hinrikus** co-founder, TransferWise; **Andreas M Antonopoulos** author and entrepreneur ◆ **Alexa Clay** co-author, *The Misfit Economy*; **Ismail Ahmed** CEO and founder, WorldRemit ◆ **Francisco González** CEO and chairman, BBVA; **Darren Westlake** co-founder and CEO, Crowdcube; **Julie Hanna** executive chair of the board, Kiva

This page, clockwise from top left:
Mike Lynch founder, Invoke Capital
◆ **Valentin Stalf** CEO and co-founder, NUMBER26; **Hiroki Takeuchi** CEO and founder, GoCardless; **Raphael Ouzan** CTO, co-founder and head of product, BillGuard
◆ **Jonathan Vaux** executive director, innovations partnering, Visa Europe; **Roelant Prins** chief commerce officer, Adyen
◆ **Stefan Thomas** chief technology officer, Ripple Labs; **Céline Lazorthes** founder and CEO, Leetchi and MangoPay

‘IT’S CHARACTER-BASED LENDING AS OPPOSED TO COLLATERAL’

Julie Hanna

BUILD A NEW WORLD BANK

Julie Hanna
Executive chair of the board, Kiva; US Presidential ambassador for Global Entrepreneurship

Peer-to-peer lending has created connective capital, a whole new class of capital, and is well on the way to founding an alternative to the World Bank, Julie Hanna told WIRED Money.

Kiva – and its 1,500-odd competitors such as Zopa, Lending Club and Kickstarter – has created a default "world's bank", she argued. "The World Bank itself is a top-down mechanism that funds institutions," according to Hanna. "The world's bank is a bottoms-up, nimble, person-to-person network that funds and gets money into the hands of entrepreneurs where they need it the most. Connective capital has some unique characteristics. It's patient, it's risk-seeking, not risk-averse; it's accountable, it's transparent. It's allowing us to bring business to all of humanity and humanity into the way that we do business."

Kiva was founded in 2005. Its total loans have grown from $5 million (£3.2m) in 2007 to a total of $1 billion projected by 2017. The network now has 1.3 million lenders across 190 countries investing an average of $400 each, funding 1.6 million entrepreneurs across 86 countries. About 98 per cent of loans are repaid in full.

"Somewhere along the way, Kiva became the largest funder in post-conflict Africa," Hanna explained. "Every one of our 1.3 million lenders has made a loan in sub-Saharan Africa." Kiva's borrowers range from solar businesses in New Orleans to young women rescued from sex trafficking in Cambodia who were looking for capital to start a sewing co-operative. Women make up 80 per cent of the borrowers.

"The power of the wisdom of crowds is the fact that people can qualify and connect and vote with their dollars in a way that no amount of loan officers ever could," according to Hanna, whose inspiration came from her childhood experiences as an immigrant. She was born in Egypt and her parents then fled from Lebanon for the US, but found it hard to get access to resources there. "It's character-based lending as opposed to collateral credit-based lending. In essence, it's rehumanising banking."

GLOBAL PAYMENTS WORK IF TREATED HYPERLOCALLY

Roelant Prins *Chief commercial officer, Adyen*

Success is about thinking globally but acting at a very personal level, Roelant Prins of Dutch payments giant Adyen, advised the room. "We went global from day one and that made the difference," Prins explained. "Our first customer was German, not Dutch. But using big data we can understand the behaviour of individual customers – and understanding cultural differences is a huge opportunity." Adyen positions itself as a single global platform processing £35bn annually. It employs 300 people and raised £250m last autumn against a £1.5bn valuation – with Spotify, Airbnb, Dropbox, KLM and River Island as customers.

The key number is the 250 payment methods Adyen supports worldwide, bringing them together into a single system. Using big data, Adyen can create a broad picture of a shopper – connecting behaviour and choices with ID to reduce risk, but also allow personalised relationships on the high street. "All the data on mobile and online is super-valuable, but if you look in-store there's nothing," Prins explained. "You walk in to a store, they have no clue who you are. We can now combine point-of-sale payments with the online infrastructure so you stick your card into a terminal and we can tell the retailer, 'This guy purchased online over the past few months for quite a lot of value.' That's gold for retailers."

CONSUMERS MAKE BANKS EXTINCT

Taavet Hinrikus
Co-founder, TransferWise

Banks are in for a hard time and will be replaced with something more user-centric, warned Taavet Hinrikus, co-founder of the London currency company valued at more than $1 billion. "Bill Gates once said, 'Banking is needed but banks are not,'" he told the audience. "I'm convinced tech companies will own 40 per cent of banking in the years to come."

TransferWise, he explained, was born of personal frustration. As a Skype employee in London he was paid in euros, and his now business partner Kristo Käärmann was paid in sterling, but needed euros to pay a mortgage. Fed up with losing money in bank fees, Käärmann put pounds in Hinrikus' British bank account, and Hinrikus put euros in his friend's Estonian account. The idea for TransferWise was born. Launched four-and-a-half years ago, the peer-to-peer company now transfers around £500 million a month, saving, Hinrikus claims, £22 million in banking fees for customers every month.

"In the UK today, TransferWise is about five times faster and about ten times cheaper than your bank," he said. "But more importantly, it's about transparency. It's about not hiding any of your fees, not having a mark-up on the exchange rate and being brutally honest about what you're doing for the consumer."

His vision for the world of banking was for TransferWise and others at the conference – such as GoCardless and Funding Circle – to replace key banking services. However, fintech companies needed to focus more on the consumer. "Consumers drive change in fintech but, really, consumers don't care about it," he argued. "Don't do innovations you think are cool, do what consumers think is cool. And as a consumer, I'm waiting for what's going to come after banks."

INNOVATORS COME FROM THE EAST

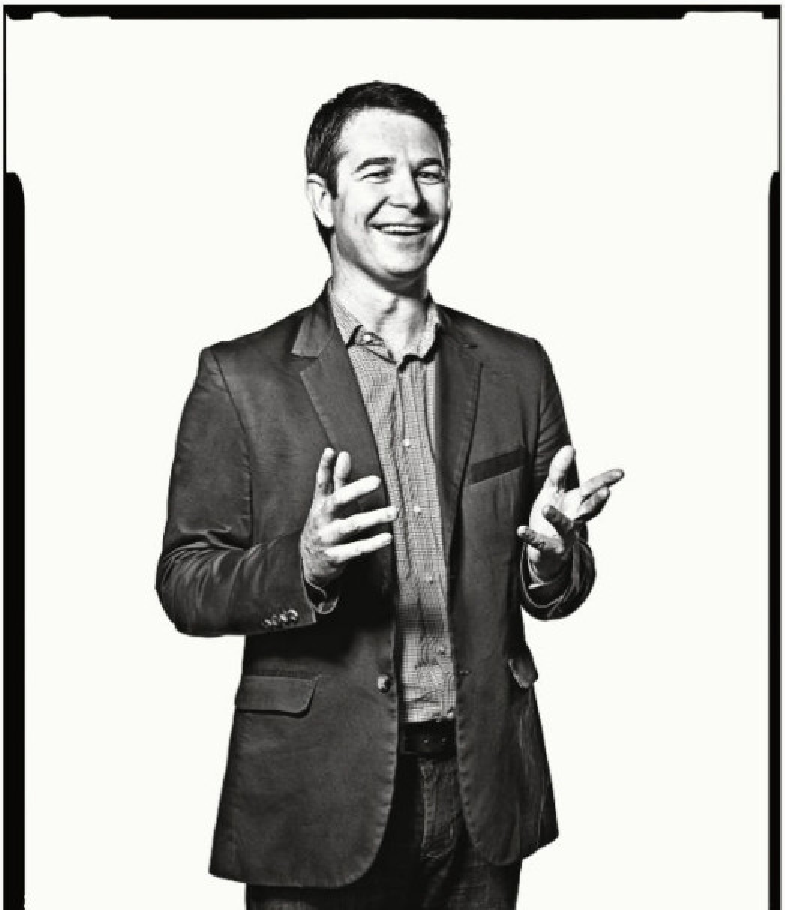
Brian Forde
Director of digital currency, MIT Media Lab

Bitcoin – and its fellow blockchain cryptocurrencies – will do for payments what email did for communication, argued Brian Forde, MIT Media Lab director of digital currency. The technology, he said, could even foment a new global capitalist revolution. "When we started out with email, you could only get mail from other people on your platform," he explained. "It wasn't until we had the open protocol SMTP that we could start sending emails to Hotmail and Gmail. Cryptocurrencies are the open protocol of payments – the SMTP of money."

Forde compared eBay to AOL: "What's the eBay stack? The transfer of money, your identity as a buyer or a seller, your reputation as a buyer and seller and then the marketplace," he said. "Suddenly you have these open protocols so you're no longer stuck on eBay and you're dealing with everyone. People talk about Uber and Airbnb as disruptive – but they're intermediaries just like the incumbents. This open protocol actually disrupts the disruptors."

Forde is investigating the security, stability and scalability of the blockchain, ways to spread the system to increase diversity and its possible impact on the developing-world economy. "Capitalism took off in countries such as the US with most small-business owners borrowing against their home," Forde argued. "Where people don't have a formal property title, like in Egypt, all this capital is tied up. If you have a property title put on the blockchain, even if there is then a government that no longer respects the title, it's on the blockchain: the government can't say you never owned it. In Egypt, that unlocks $400 million in capital."

A few months ago, Forde gave a workshop on Bitcoin to more than 30 Iraqis with non-technical backgrounds. They started sending money to one another and coming up with ideas he couldn't have foreseen. "We're going to see innovations come from nations where financial infrastructure isn't strong – rather than from the west," he argued, predicting a revolution in financial services by and for the millions who've had no such access to date.



FINANCIAL LITERACY SHOULD BE A HABIT

Raphael Ouzan
Co-founder, BillGuard

In a room full of VCs, founders and entrepreneurs, the warning from Raphael Ouzan, of personal-financial-security firm BillGuard, that fintech is in peril gave the conference an electrifying start.

"Many industries have taken giant steps forward but we have not," he argued. "Blaming regulation is an excuse for now but won't hold for much longer. We need to learn from services like Uber."

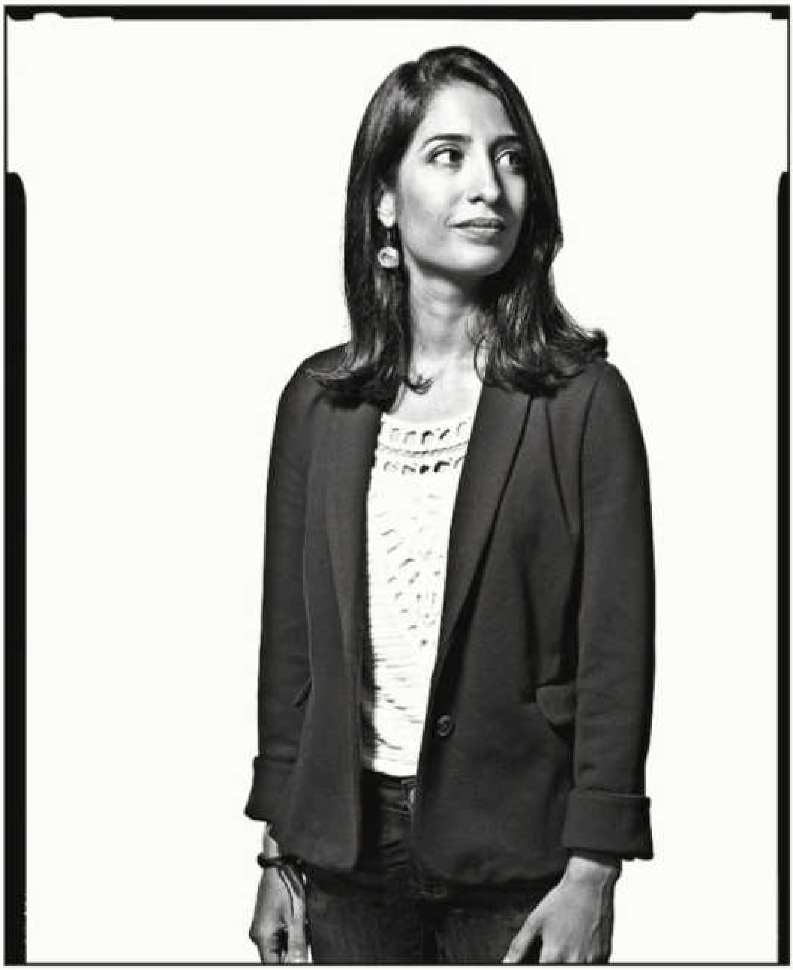
Ouzan's experience launching BillGuard – an anti-fraud service which scans users' credit-card accounts for questionable transactions – helped him understand the problem, he explained, because BillGuard was launched to huge acclaim and then almost vanished.

"We designed a service that is very simple to use. Thousands of people got into the service, the press and social media lit up and the technology actually worked," he explained. "But people stopped using us. We focused on the function and saved people money, but one key element was missing: engagement. If it doesn't become a part of your daily life it doesn't matter. It was not relevant... This is what's wrong with our industry. A lot of our products are just not relevant for our consumers."

That's the Uber lesson, he insisted: "Instead of focusing on the payment, they reshaped the experience so we use it over again because we love it. PayPal, MasterCard and Visa have put so much investment into mobile wallets – but it was the *Starbucks* app that made mobile payment work because the whole experience of getting your coffee in the morning was improved."

The problem is people's "traumatic lack of financial literacy", he suggested. "My father performs open-heart surgery and doesn't know the difference between a bond and a stock. Donna Haley, a prominent behavioural economist, calls it the 'now versus later': if you walk into an Apple Store you can literally feel what a $1,000 Apple Watch would feel like on your wrist. That's a very clear benefit. But what would that $1,000 look like in 30 years from now if you invested it?"

He and his team asked themselves how to create an app that would get people to check bills. This led to an app that turns your bank accounts and services into a list of items that reinforce the habit of paying attention to your money. "If you run this loop enough times you get a habit. A habit makes a service relevant," he said. The app hit the top of Apple's finance charts in several countries, and was one of the best of 2014 on Google Play. Other fintech companies take note, he urged: "Make financial services relevant so we can save consumers from financial illiteracy."



CREDIT SCORING IS OUTDATED

Shivani Siroya
Founder, InVenture

With 2.5 billion people in the world lacking any financial identity, prevented from borrowing money and unable to build businesses to drive economies, the question from Shivani Siroya, CEO and founder of InVenture, was simple: could we build that identity for people by looking at their data? InVenture has gone some way to solving it in Kenya with an Android app called *Mkopo Rahisi* – "easy loan" in Swahili – which gathers an average of 10,000 data-points per user, including financial transactions, social-media accounts and web searches, to build a rich personality profile. It can deliver instant credit access in less than a minute direct to a user's mobile money account. Kenya's mobile-money market interested a number of conference speakers – there are over 26 million mobile-money accounts in the country and 43 per cent of Kenya's GDP is said to flow through mobile money. *Mkopo Rahisi* has loaned $1.5 million with an 85 per cent overall repayment rate.

"Our customers use our product more like a revolving line of credit, more like a credit card than the traditional loan product," Siroya explained. "Over 60 per cent of our customers use it for working capital." She cited one of her Nairobi-based customers – Brenda – who sold curtains door to door. After struggling to expand her business, she used *Mkopo Rahisi*'s loan, initially for inventory, but she came back every month. Brenda has now invested in a store front, taking her off the city's dangerous streets.

Siroya aims to be in two more countries by the end of this year. "Beyond credit, we've built more meaningful pictures and financial identities for the newest and most overlooked consumers – those who are incredibly profitable and valuable customers," she explained. "We've given them the power of choice to build better financial futures."

TRY TO CATER TO ALL, NOT JUST THE MILLENNIALS

Jonathan Vaux
Executive director, innovations partnering, Visa Europe

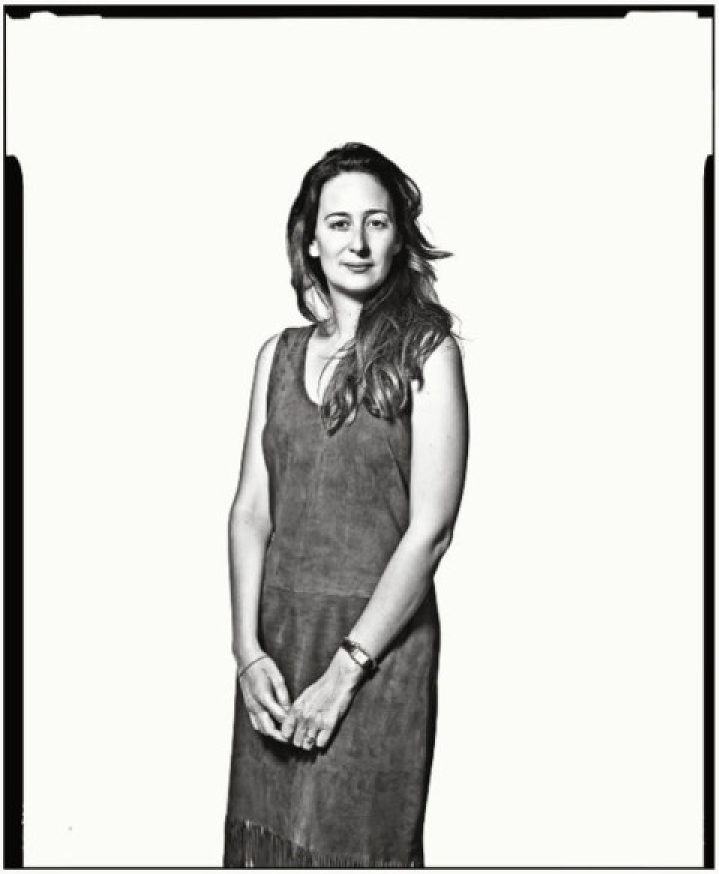
On a day when speaker after speaker warned of a gloomy future for banks, Jonathan Vaux was in agreement: financial-service incumbents needed to guard against complacency, he said. But he also warned that many fintech startups needed to do some basic homework if the promised revolution is ever to come.

"I see a lot of startups who want Visa's brand, money and distribution," he explained. "You'd be amazed how few give me any sense of what's in it for me as the provider of that service. One of the top three pain points that I have working with the startup community is getting them on to our books so that we can pay them for the services they're providing. Most won't pass the credit check that's necessary to be a supplier – a problem some simple preparation would overcome."

His dream, he explained, was to disrupt the usual narrative of startups taking on giants of payments such as Visa and stealing chunks of their business. Instead, intelligent firms on both sides should learn to work together. "There are people who say that startups and incumbents can't work together – but I think, like peanut butter and jam, there are combinations that shouldn't work but can," he insisted.

Visa, he explained, is talking to startups in areas such as identification, device fraud, cloud services taking some of the pain out of online payments, digital receipting and even Bitcoin. "The smart players are taking all those elements – what I call the LEGO-fication of payments – and choosing and building solutions that are fit for purpose and variable."

He had a final plea: "Every solution I see is looking at millennials – many are so specific and focused on the millennial that it may be hard to appeal to anyone else," he explained. "But these won't be most organisations' best customers."



PAYMENTS NEED TO COLLABORATE

Céline Lazorthes
Founder & CEO, Leetchi and MangoPay

The fintech world isn't ready for the collaborative economy, Céline Lazorthes warned the conference – and it stands to lose out on millions of pounds unless it understands the needs of crowdfunding platforms and the like.

Lazorthes, who launched e-wallet provider Leetchi back in 2009, was stunned when a friend who ran a crowdfunding site explained how difficult PayPal payments were proving. "The user experience that PayPal provided him meant payments went directly to the project owner – so they didn't know who was paying and who wasn't paying," she recalled. "PayPal wasn't made for a collaborative economy. It was made for retaining, it was made for e-commerce, but not for this kind of platform."

Crowdfunding sites also suffer when pledges are made before payments are needed – all the site can do is authorise a credit-card payment at the time of the pledge. "You can't store the payment while the project is collecting – so you make an authorisation and maybe two or three months later you try to debit the card and 20 to 30 per cent of transactions are rejected," she explained.

MangoPay is her solution. Launched in 2013, it combines the e-wallet know-how of Leetchi with an API that allows customers to hold an e-wallet of pledges and transfer them to the project owner on completion – or back to the pledgee if the project fails.

Six hundred crowdfunding sites, marketplaces and collaborative-consumption platforms in 22 countries use MangoPay. In 2013, the system collected €45 million; in 2014, it took €100 million and is on course to reach €200 million this year. Pressed on the risk of copycats, Lazorthes was sanguine. "Building technology like this takes time and money," she said. "It took us four years. So we have a head start."

THE BBVA VENTURES STARTUP STAGE

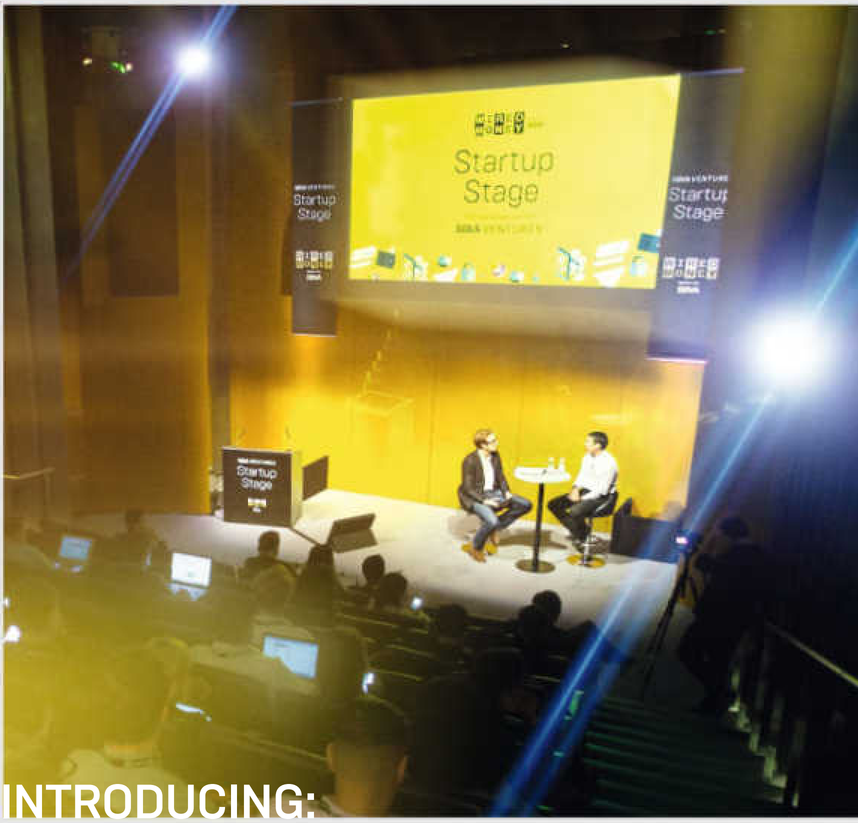
Representatives from 18 nascent fintech companies spent nine minutes pitching to the WIRED Money audience of experts and investors

Michael Madon RedOwl
Bastien Bourdon (*below*) edgefolio
Emily Mackay Crowdsurfer
Daniel Gandesha Property Partner
James Smith Elliptic
Andy Goldby The Floow
Gonçalo de Vasconcelos SyndicateRoom
Lúí Smyth CoinJar
Nikolay Storonsky Revolut
Julian Oehrlein Oradian
Kerim Derhalli invstr
Alon Feit PayItSimple
Mark Lamb Coinfloor
Gerald Eder CompareAsiaGroup
Aron Rissman ThetaRay
Dylan Bourguignon Syndico
Ami Daniel Windward
Kaylan Tildsley Triton Research

WATCH WIRED MONEY ONLINE

You can see and hear the speakers from the main stage at *wired.co.uk/wired-money-2015*

PHOTOGRAPHY: MICHAEL PALEODIMOS



INTRODUCING:

The WIRED Money startups

THE WIRED MONEY START-UP STAGE, IN PARTNERSHIP WITH BBVA VENTURES, HAD 18 COMPANIES PITCH FOR A CHANCE TO PRESENT THEIR IDEA IN THE MAIN ARENA

After hundreds of bottles of water, countless audience questions and numerous judges' deliberations, the 18 businesses pitching the BBVA Ventures Startup Stage became one as Oradian was crowned winner.

Oradian's software enables financial bodies in emerging markets to offer cheaper and more scalable products.

"Together with our customers our vision is to serve 100 million families in the next five years," said co-founder and COO Julian Oehrlein. "That means we will serve over half a billion people and give them access to financial services they so desperately need."

His prize was to present the final Main Stage session. The stage judging panel included Jess Williamson of Techstars, Accel Partners' Seth Pierrepoint and Jay Reinemann, executive director at BBVA Ventures.

"The judges chose Oradian because they are having success in solving the lack of banking infrastructure in places like sub-Saharan Africa," explained stage host and WIRED assistant editor Oliver Franklin-Wallis.

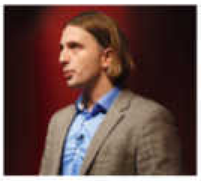
As a partner and investor in fintech startups, BBVA Ventures supported the stage because of the role that nascent ideas play in the future financial landscape, says Reinemann.

"So much of the technology that's going to bring transparent, digital mass-market financial services is coming from the startup community," he said. "Our backing for the Startup Stage, the creation of BBVA Ventures and our Open Talent competition is our investment in, and support for, this new ecosystem." *bbvaventures.com*

A SELECTION FROM THE STARTUP STAGE

SOME OF THE BEST PRESENTATIONS AT THE WIRED MONEY EVENT CAME FROM THESE GROWTH-STAGE COMPANIES

Windward is an Israeli data and analytics company that concentrates on the maritime domain.



Revolut's international money account has a physical card, no fees and instant cross-border payments.

Oradian empowers the financial institutions in developing nations, improving performance and reducing costs.

RedOwl helps firms monitor and investigate high-risk activities inside their enterprises using data analysis.

invstr aims to open up access to financial news and data with an intuitive, real-time market sentiment app.

The Floow provides motor insurers with actionable analytics to increase customer loyalty and ROI.

Syndico's Cycle Syndicate product offers a cheaper, peer-to-peer alternative to traditional insurers.

CoinJar is a personal account and digital wallet that allows its users to acquire, store and spend bitcoin.

PHOTOGRAPHY: MICHAEL PALEODIMOS

Transforming the bank for the digital era

AT WIRED MONEY FRANCISCO GONZÁLEZ, BBVA'S CHAIRMAN AND CEO, EXPLAINED HOW THE BANK IS EVOLVING – USING DIGITAL TECHNOLOGY AS THE CATALYST

"Few incumbents will be at the centre of the future financial ecosystem," said Francisco Gonzalez, chairman and CEO of BBVA, in his WIRED Money keynote. "But we're trying to be an exception."

So what separates BBVA from other established players? Firstly, González explained, the bank invested in a new technology platform to support its future. This scalable, future-proof solution is now handling 400m digital transactions daily, and is expected to support 1.2 billion per day by 2020.

The platform has also allowed BBVA to build customer-focused products faster. The bank's mobile payment app, *BBVA Wallet*, launched nine months ahead of *Apple Pay* in Spain. It allows users to pay using a smartphone and to turn cards on and off when lost, for example. More than 730,000 users have downloaded the app in Spain and it'll shortly be available in the US, Mexico and Chile.

Interrogating Big Data – which, González says, is a key competitive advantage for BBVA – has also been simplified by technology. "We can now segment 6.5 million customers in five hours – something that used to take us two months," he explained.

450m
Daily digital transactions

$100m
BBVA Ventures fund

730k
Downloads of *BBVA Wallet* app

Next, BBVA set about changing its culture and organisation to lend greater focus, flexibility and dynamism to the company. An on-going project, this saw the creation of a dedicated Digital Banking business. "We learnt two key things from our Digital Banking division," said González. "Number one is that the speed of change is accelerating and secondly, that we were ready to step up the pace."

This saw Carlos Torres Vila, formerly head of the Digital Banking area, move to become BBVA's new chief operating officer.

As well as a new technology platform and changes to the organisation, the other key component of BBVA's strategy to ready itself for the future is investment and support for the digital community. "Collaboration is the essence of successful digital change," said González.

In 2013, BBVA Ventures was set up as a stand-alone business in California with a fund of $100 million to invest in, learn from and assist fintech startups. It has since directly invested in ten startups including bitcoin wallet Coinbase. At WIRED Money González announced that the fund is now looking to invest in Europe, with a particular focus on London. BBVA also supports startups through its own Open Talent competition. The 2015 edition of the contest has three regional finals, over 40 finalists, and for the first time, features an award for Financial Inclusion, awarded to Chile's credit-scoring startup Destacame.cl.

While recognising that change is ongoing – "our transformation is in progress and far from complete" - González insisted that we shouldn't just take his word for it that BBVA is well-positioned for change.

"Last month, Nobel Prize Winner Myron Scholes said the impact of technology in banking is such that in ten years nobody will be able to recognise today's industry. He then singled out one bank that was taking the challenge seriously – BBVA."

For Open Talent, centrodeinnovaciobbva.com/en/opentalent/finalists

> "We can now segment 6.5 million customers in five hours – something that used to take us two months."
>
> **Francisco González, BBVA chairman and CEO**

PHOTOGRAPHY: NICK WILSON; LEON CSERNOHLAVEK

WORKING BREAKFAST:

AHEAD OF WIRED MONEY, BBVA AND WIRED CO-HOSTED A SESSION TO DISCUSS HOW STARTUPS AND BANKS CAN COLLABORATE FOR THE BENEFIT OF THE CUSTOMER

Teppo Paavola, chief development officer and GM of new digital Business at BBVA and Jay Reinemann, executive director of BBVA Ventures were joined by WIRED's Greg Williams, plus a VIP audience, for a discussion about the benefits of incumbents treating potential disruptors as allies on a mission to improve services for consumers.

For BBVA Ventures, visit bbvaventures.com

The Cambridge Executive MBA

"Cambridge has this critical mass of academic and business expertise, capital & connections. It's a cluster of a sort that's hard to find anywhere else in the world."

Eben Upton
Inventor & Entrepreneur
Co-founder, Raspberry Pi Foundation
Cambridge EMBA 2009

The Cambridge EMBA is a 20-month degree programme designed for senior executives

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See where it takes you

HOW TO

ILLUSTRATION: GIACOMO GAMBINERI

How to...

OPTIMISE SLEEP

We spend more than 30 per cent of our lives in bed, but that does not mean we are good at sleeping. A 2014 University of Hertfordshire study found that six out of ten Britons don't get enough shut-eye; a US Centers for Disease Control and Prevention survey found that one third of Americans don't either – and its consequences are far from trivial. "A sleep-deprived society is more accident-prone, more dangerous," says Jessa Gamble, author of *The Siesta and the Midnight Sun*. Gamble examined how military-funded scientists were engineering technologies, from stimulating drugs to brain implants, for people to sleep effectively. Sadly, there's no substitute for a deep rest, so Gamble recommends practising good sleep hygiene to maximise the quality of your snooze. **Gian Volpicelli** >

1. EXERCISE
Scale up your workout schedule, as regular physical activity helps abate stress, which allows you to fall asleep more rapidly. "Exercise is a good way to set your daily rhythm," Gamble says. But she advises against doing your push-ups just before bedtime as it will stimulate you and heat up your body.

2. REDUCE STIMULATION
Try to avoid using screen technology because the blue-light screens of computers, tablets and smartphones trick our brain into believing that it is still day. Gamble suggests that you at least invert the colours of your screen (from the settings menu). There are also apps – such as *f.lux* – that shift screens' light into the more sleep-friendly red spectrum.

3. GET COSY
Ensure your room is quiet, cool and dark and that your bed is cosy. State-of-the-art smart covers, such as the Luna, will adjust the temperature for you. "The heat of our skin, and our level of arousal, are regulated by the same part of the brain," Gamble says. Acting on these neurons should accelerate the process of drifting off.

4. SET YOUR CLOCK
Ideally, you should get seven to eight hours of sleep a night and set a routine. A sleep-wake cycle hinges on the production of a hormone called melatonin. Artificial light can tamper with this, so Gamble suggests a dark room. Controlled waking is just as important, so consider an app such as *Sleep Genuis* to monitor your sleep patterns and wake you at the optimal time. Or invest in a Lumi clock, which will wake you with a 30-minute artificial sunrise to boost your serotonin levels.

5. ...AND RELAX
To swiftly enter the land of Nod, use an app such as *Relax Melodies* – presently one of the most popular apps, boasting ten million users – to play ambient sounds like waves or rain, on a timer. Alternatively, *Headspace* is a guided meditation app with breathing exercises to relax.

How to...

OWN AN AUDIENCE

Whether it's getting up in front of an audience of 1,000 guests or ten overworked employees, public speaking can be unnerving. Michael Weitz and Abigail Tenembaum, founders of Virtuozo, coach everyone from TED speakers to CEOs to express their message effectively. "It's like a musical instrument, everybody can learn with enough practice," says Tenembaum. This is their advice for getting your point across. Sophia Epstein

1. Understand your message

"One thing that is critical is knowing your key message," says Tenembaum. "It sounds simple but often articulating the idea in a concise way is the hardest thing." Once you understand your point, it will be easier to express it. Also understand who your audience is: a common mistake is to put yourself as the audience. Instead, think about who they are at that exact moment. "Even the same audience is different at 9am on a Monday than it is after a long day of presentations at 5pm."

2. Connect with your audience

Look at them, don't stare, but speak directly to them and check they are staying engaged. "A lot of people launch into their message and don't check back in with the audience until they're done," says Weitz, when instead your attention should be on them the entire time. "It's more than eye contact," he adds. "Make sure they're engaged, and if they aren't, adjust." That might mean throwing aside the PowerPoint, or adding in a personal anecdote if your message can go off-script.

3. Have a conversation

Don't think about your words. "If you ask attendees of TED talks what drives them crazy, it's when speakers talk like they're reciting a memorised text," says Weitz. "They want the speaker to be speaking directly to them." Don't get bogged down trying to recall your talk word for word. "Remember, people don't know what you've prepared," says Tenembaum, explaining that people are impressed by passion, emotion and data. "They don't care about the words, they care about the meaning."

4. Keep it clear

Words should not get in the way of your message. Don't use jargon: your audience will not relate to obscure language. "As an audience, we tend to notice written language as opposed to spoken language," says Tenembaum, so using words more at home in a textbook will isolate you. Speak slowly and assertively. "If you speak fast in a low voice, your impact will not be what it could have been." And practise; just reciting the beginning and the end will improve your presentation.

5. Don't be afraid to pause

If you have a sudden memory lapse, don't panic. "Most people will put their foot on the accelerator," says Weitz. "But do the opposite, put your foot on the brake. Take a moment, take a breath. The audience will think you are making a dramatic point." As long as your eyes stay on the audience, and not the ceiling or the floor, they will be none the wiser. "You're in a different time zone from the audience," says Weitz, so 30 seconds might seem like minutes to you, but will breeze by for the audience.

6. Move for a reason

When you pace up and down the stage it's distracting to the audience. "You need to give a nice clear signal that the audience can tune into," says Weitz. "And pacing around or meandering can take away from that strong signal." Instead, think about the key points you are going to make and move to emphasise them. "Turn to somebody else in the room after a key point to make it more dramatic," suggests Weitz, "or walk to a different part of the stage if you want a change of energy."

7. Use your hands

"Michael says that hands are the analogue version of PowerPoint," says Tenembaum. But you shouldn't plan your movements like you would your slides. "When we are explaining things our body will naturally make gestures that can enhance our communication abilities," says Weitz, "and that can enhance the way people understand things." Try not to focus too much on it; it's like breathing – when you think about it, it becomes irregular, but when you don't, it happens naturally.

8. Keep your body open

"Everything sends a message," says Tenembaum. "Not just the words you're saying." So be aware of your body language as it can put a barrier between you and the audience. And if what you're saying conflicts with your body language, the audience will notice something is out of sync. "When we receive a message, we tend to lean more towards the body language," says Tenembaum. "If a manager tells his team he trusts them with his arms crossed, it's likely his message won't get through."

9. Set the tone

Make sure that your tone reiterates the point you are making. "Tone gives meaning," says Tenembaum. If you give a statistic – for example, sales went up by 35 per cent – the tone will reveal whether that is positive or negative. It can also switch up the tempo. "Our brain is an efficient machine that will try to save energy," says Tenembaum, "so it will go into power-save mode if it can." Bring variety to your tone, pace and the content to keep away from being monotone.

ILLUSTRATION: ANDREW THOMPSON; ISABEL GREENBERG

How to...

MAKE YOUR OWN MONITOR MOUNT

One monitor on your desk doesn't take up that much space, but add another and you may develop a real-estate problem. Construction inspector and DIY enthusiast Mike McRae decided to build a mount from iron pipe, which, according to him, is "strong, durable, cheap and flexible", and requires only a little DIY know-how.
Jeremy Cook

YOU'LL NEED:

- A monitor set up for VESA mounting
- **Three pieces of 20mm threaded iron pipe (two 30cm, one 45cm)**
- One 20mm pipe tee
- **Four 20 mm metal hex nipples**
- Four 20mm metal elbows
- **One 20mm floor flange**
- Four 20mm-long M6 screws
- **Four pipe straps**
- Eight 20mm M4 screws with nuts
- **Two double-wall outlet plates, larger than the monitor's screw-pattern**

1. ASSEMBLE THE PIPE
Screw a hex nipple into the pipe flange, then into an elbow. On to this, attach the 45cm pipe and a tee, with the two remaining openings pointing up and sideways. On top of this tee, attach a nipple, an elbow, and a 30cm pipe. Attach a nipple to the tee, then an elbow facing upwards. Attach a nipple to this elbow, screw another elbow on, and a 30cm pipe.

2. ATTACH THE MONITORS
Drill your outlet plates in a pattern for the monitor's mounting holes, as well as for two pipe straps. Attach the plates to the pipe using the straps, then mount the monitor with screws. Screw the assembly into the back of your desk via the floor flange and M6 screws. Mike's desk is "old and very solid" – necessary for this type of attachment.

How to...

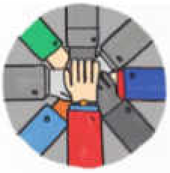
BECOME AN ANGEL INVESTOR

When I first started as an angel investor I was excited to start investing in startups – but I didn't know much," says Gil Penchina, who now heads the highest-value syndicate on AngelList with more than $6 million (£4m) of backing. "I couldn't tell the good ones from the bad, I didn't understand all these venture capital terms, so I would invest somewhat blindly." So, why go it alone? With a syndicate, you can invest alongside people with experience, better connections and access to deal flow – a higher rate of business transactions.

"If you have the deal flow as an individual then that's great," says Nancy Fechnay, who heads Penchina's first UK syndicate, Flight.vc UK, alongside him. "But usually, people can't possibly see every great deal that's in the market all by themselves." Most syndicates have hundreds of thousands of dollars in backing, from anywhere between two and a few hundred backers – depending on their minimum-investment requirement. By joining a syndicate, investors can also invest sizably less than they would need to as an individual investor. So, if you're interested in making startup investments, but don't want to gamble as much money, here's how to get a piece of the action. SE

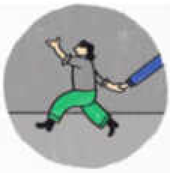
GET ACCREDITED

AngelList allows international investors to back American syndicates. Backers must meet American standards and either have a net worth of $1 million or have earned $200,000 in each of the previous two years. "We ask investors to meet the accreditation standards because tech startups are not right for everyone," says Philipp Moehring, director of AngelList UK. "We want them to be aware they can lose money too, because that's what startup investing is like."



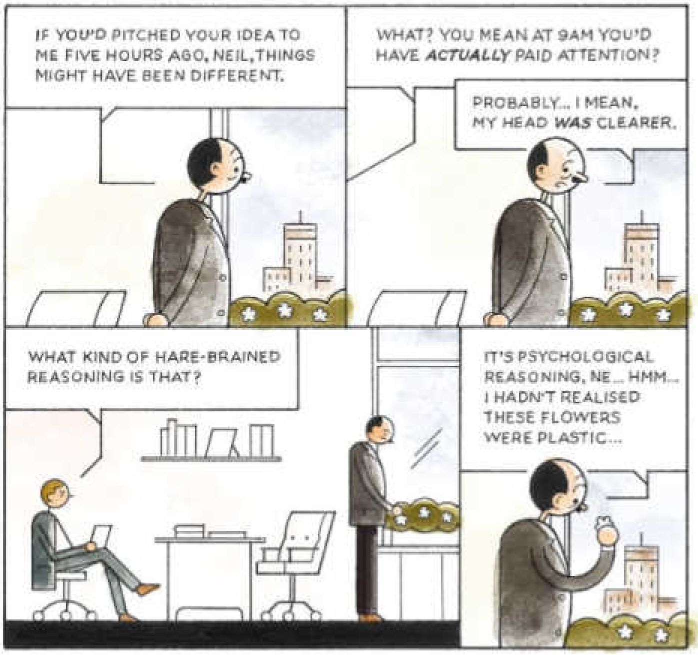
FIND A SYNDICATE

There are hundreds of syndicates, including 15 in the UK, so don't be hasty. "Look at the syndicate leads, their connections, what deals they've done before," advises Fechnay. "And check what resources they have at their disposal, so they're getting the best deals and also providing their companies with support." You can pick a syndicate dedicated to a certain area – from Bitcoin to the UK. "You're looking for someone with a thesis that matches yours," says Penchina.



RESEARCH THE LEADS

Leads are not limited to serial investors. They range from venture capitalists like Jenny Rooke (£325,000) to Stanford law professors such as Jeff Schox (£82,000). Many are entrepreneurs: Wayne Chang, whose startup Crashlytics had angel funding before being acquired by Twitter, raised £623,000. The majority don't invest often but some are active. Jason Calacanis' and the FG Angels syndicates have, since 2014, made 11 and 33 investments respectively.


IF YOU'D PITCHED YOUR IDEA TO ME FIVE HOURS AGO, NEIL, THINGS MIGHT HAVE BEEN DIFFERENT.
WHAT? YOU MEAN AT 9AM YOU'D HAVE *ACTUALLY* PAID ATTENTION?
PROBABLY... I MEAN, MY HEAD *WAS* CLEARER.
WHAT KIND OF HARE-BRAINED REASONING IS THAT?
IT'S PSYCHOLOGICAL REASONING, NE... HMM... I HADN'T REALISED THESE FLOWERS WERE PLASTIC...

How to...

CAPTURE PEOPLE'S ATTENTION

Getting yourself noticed is challenging, but Ben Parr, San Francisco-based entrepreneur and author of *Captivology*, knows all the tricks. "Attention is the fundamental currency of the modern economy. It's our capability to listen, to remember something and care about it," he says. "But very few people understand how it works, how it applies, and how to harness it." After companies and startups repeatedly asked him about the best ways of grabbing attention from press, customers and investors, Parr started investigating. The trick, he claims, is to capture your audience's immediate, short-, then long-term attention, so that your listeners stay focused on what you have to say. Follow his steps and you'll be standing out from the crowd in no time. Emiko Jozuka

GET IN ON THE ACTION

Once they've been accepted, backers are notified each time the lead investor syndicates a deal. They can choose to opt out if they don't wish to convert their backing into a reservation – an indication that the investor wants to invest. When enough reservations are confirmed, the investors will be invited to close. Converting a backing to a reservation is non-binding, but pulling out of a deal often may result in the lead removing them from the syndicate.

KNOW THE RISKS

The companies backers invest in are just starting out; they are usually run by young teams and will have to overcome many challenges. "Investing in this asset class is quite risky," says Penchina. "Angel investments have a high likelihood of failure." Because of this, backers should consider how much money they could afford to lose and be cautious. Penchina's advice: "Limit your overall exposure to five per cent of your portfolio, or some similar small amount."

ANGELLIST EXPLAINED

AngelList (see WIRED 05.13) – an American website founded in 2010 by Venture Hacks duo Naval Ravikant and Babak Nivi – brings together startups and investors. In 2013, the site began allowing investors to syndicate deals with each other. In February, AngelList launched a UK syndicate programme.

UNDERSTAND THE DEAL

When the lead investor syndicates a deal, they will provide a rationale for the investment, and will disclose any potential conflicts of interest. Only 99 accredited investors can invest in a syndicated deal at one time. This does not mean a syndicate cannot house more than 99 backers, but it means some may miss out if they do not act quickly. "It typically takes five days to opt in or opt out," says Penchina. "Although on some of the hot ones it can go faster than that."

REMEMBER THE CARRY FEE

Because a syndicate allows investors to co-invest with other notable investors, they pay the lead investor a "carry" fee. This means the lead investor will earn an extra percentage of any profit for their involvement. The carry fee is similar to a performance fee, as it is assumed that the experience they bring will enhance the deal – though there is no guarantee that lead investors are experts here. A five per cent carry fee is also paid to AngelList.

CLOSE THE DEAL

Backers don't sign the financing documents; instead, they sign documents to invest in a nominee structure or LLC fund, which is managed by the lead investor. The fund is created solely for the purpose of investing in the company (this is done so that the startup only has to deal with one fund, rather than with excessive amounts of investors). Then the investors are invited to close, which means signing the documents and wiring the capital to the fund.

MAKE A PROFIT (HOPEFULLY)

The syndicate lead will advise the backers when to sell shares. Syndicate deals also have *pro rata* rights – if you buy a stake in a company and it releases another round of shares, you are given the option of buying more to maintain your ownership percentage. "Investors like me value it because it's essentially a free chance to buy more stock in good companies," says Penchina. "And because you get the same terms I get, you get the benefit of me negotiating for you." Good luck.

Set the agenda

"It's about doing the research to understand your audience. Once you've figured out how to appeal to them, you can leverage your ideas into a presentation," says Parr. Make sure you time your pitch well when approaching others. "Early in the day is typically better because people have fewer decisions to make and can feel more positively inclined to your ideas."

Disrupt people's thinking

If people aren't paying attention to your product, Parr recommends finding a way to disrupt their expectations. "We pay attention to things that violate our expectations of the world – it's a long psychological phenomenon," he says. "The main thing to remember about disruption is that it has to be surprising, simple and significant."

Use rewards

"Rewards are fundamental to human nature; we pay attention to rewards we desire, and to the means that we need to get them," explains Parr. For example, if someone buys your product, surprise them with an unexpected reward. "If they didn't expect it, they're more likely to remember that kind act, and to have a better appreciation of the brand."

Be known as an expert

"Either brand yourself as an expert," says Parr, "or bring in experts to help make your point." Get training in your subject and create content – blog posts, white papers, conference speeches – around a subject in which you want to be considered a virtuoso. "Once you've established yourself, it's more likely that people will come to you than the other way around."

Create some suspense

"We pay attention to mysteries because we want to complete storylines," says Parr. He recommends applying the cliffhangers or suspense techniques used in films or novels to meetings. "You don't always have to give all the information upfront – you want to have a reason to make people come back and talk more," he explains.

BEFORE WE GO ANY FURTHER, NEIL. CHECK OUT THIS CAT VIDEO MY DAUGHTER JUST SENT ME.

ILLUSTRATION: NICK D BURTON; DAVID BISKUP

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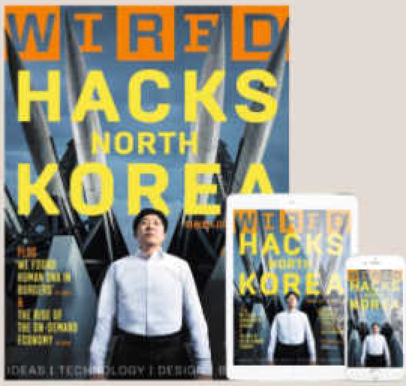

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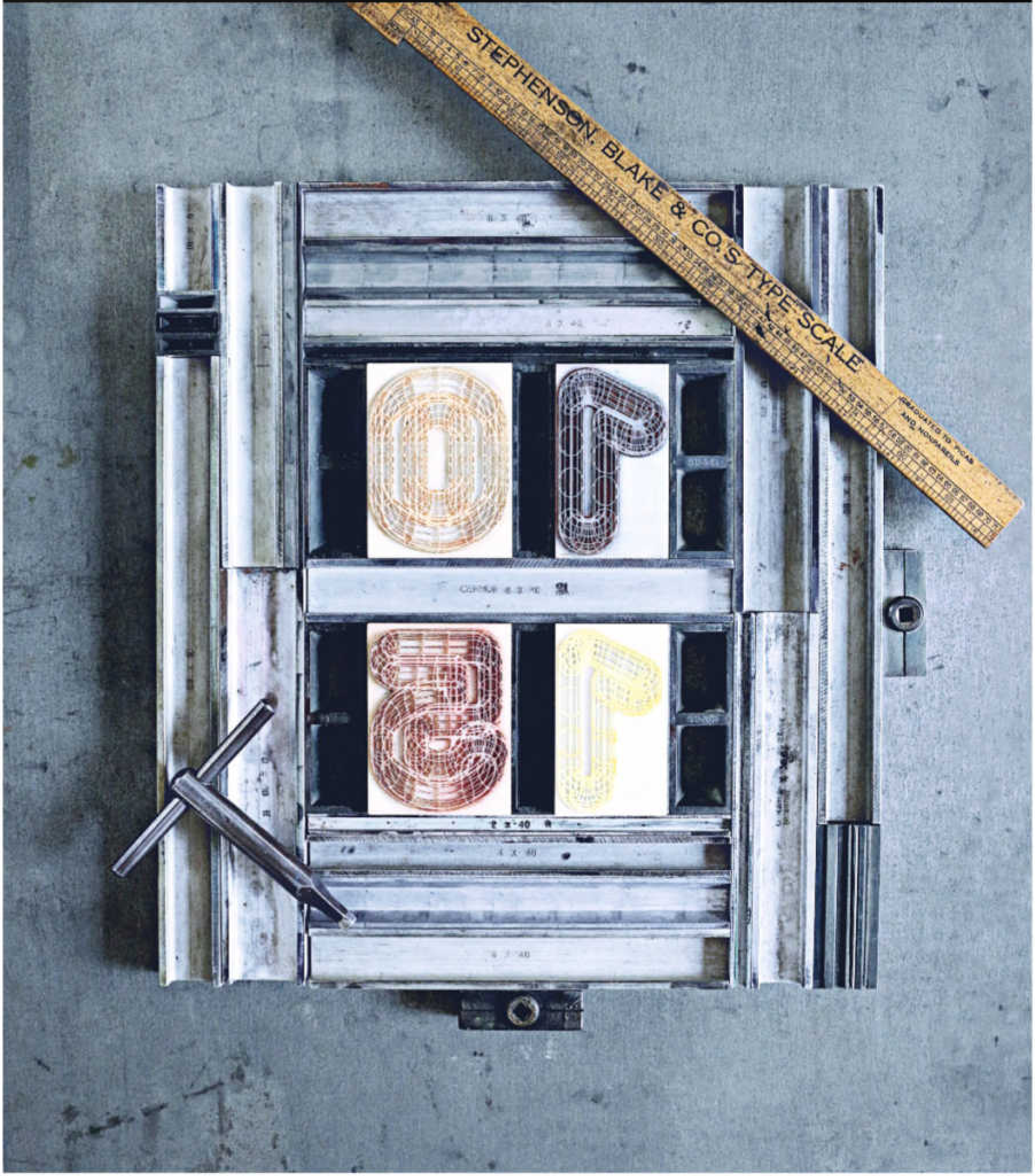
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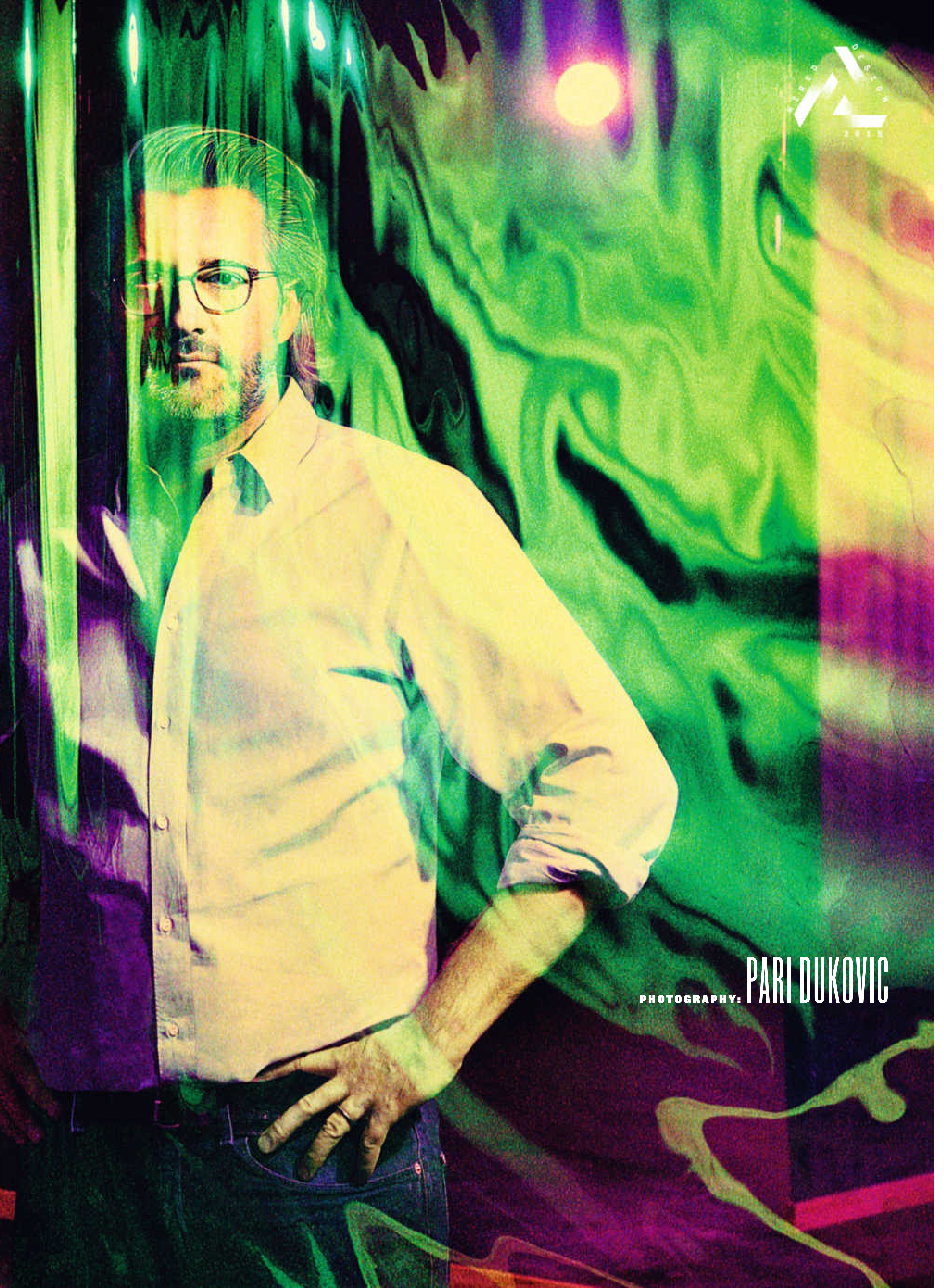
“It was one of my epiphanies. From that moment on, I did everything like a robot.” Olafur Eliasson, p118

‘ART WILL CHANGE THE WORLD’

ARTIST, SOCIAL ENTREPRENEUR, LAMP DESIGNER, ACTIVIST, BREAKDANCER, HYPER-COLLABORATOR: OLAFUR ELIASSON IS A NEW KIND OF POLYMATH

BY RICHARD BENSON



PHOTOGRAPHY: PARI DUKOVIC

WHEN OLAFUR ELIASSON, THE MULTI-AWARD-WINNING ARTIST AND POLYMATH INTELLECTUAL, FIRST TRIED MAKING AND SELLING CONSUMER ELECTRONICS, HE GOT IT AS WRONG AS HE POSSIBLY COULD.

It was autumn 2011, and he was touring villages a few hours' drive south of Addis Ababa in Ethiopia, to promote a solar-powered rechargeable LED lamp he had developed to draw attention to the cost and inaccessibility of electricity to Africans. Sales of the lamp in Europe were to subsidise those in Africa, where the distribution network would create a wealth-generating social business. Eliasson's first presentation was in a village whose residents averaged an income of $1 (65p) a day. Holding up the prototype, which was the size and shape of an iPhone 4, the kindly, bearded Icelandic-Dane explained he had invented a lamp to help poor people like them, who had little access to electricity.

It was a lovely idea, said the people, but he was unlikely to sell any here, because this was a prosperous village. Had he tried their less well-off neighbours down the road? Eliasson tried them – they averaged the same income as the first group – but this time he said, "Lamps for rich people!" The interest was immediate and keen – and only became keener as he refined the aspirational sell.

After the promotional tour, Eliasson decided the lamp had to be more attractive and with a design embodying the message about power supply. The idea was that owning a lamp would make customers consider where electricity came from, feel connected to other owners, and thus be an empowered and active part of the energy debate. It wasn't an easy brief, but what Eliasson produced did more than just appeal to consumers. The Little Sun lamp also attained the status of being an eco-friendly product people liked as much as bright, shiny, non-eco-friendly goods. With his LED lamp, Eliasson might just have reinvented the idea of what a consumer durable can be.

"Nowadays, art has great potential for changing the world and improving people's lives, partly because it can nurture a degree of trust," Eliasson says one morning in his airy, white, lightly cluttered small studio in Copenhagen. "It's important, because as politics, business and finance are losing people's trust, artists are retaining it. Culture has the highest public trust levels of any economic sector. And it can bring about not only the potential for feeling, but also for acting."

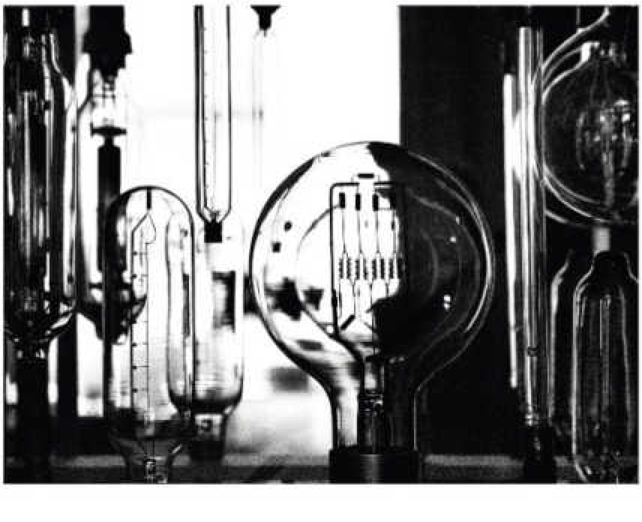
Eliasson, born in Copenhagen to Icelandic parents in 1967, is still best known for his large-scale installation art works, particularly *The Weather Project*, the 2003 creation in London's Tate Modern comprising a huge artificial Sun, mirrored ceiling and mist machine. His output is prolific and attracts interest because of the unique scope and variety of his projects: *Art Review* magazine recently reinstated him in its Power 100 specifically "for his work in pushing the boundaries of what an artist does".

Over the next few months, his work will have included the set design for a modern dance piece, *Tree of Codes*, a collaboration with Jamie xx, Jonathan Safran Foer and choreographer Wayne McGregor; retrospective exhibitions in Stockholm and Vienna; a project involving the transportation of ice from Greenland to Paris; plans for a building that will stand in Copenhagen's harbour; a cookbook; the running of his NGO (121Ethiopia) and his organisation for helping children transitioning between families; and a new product for the social business startup based on the solar lamp. Oh yes, and the small matter, which he mentions only in passing, of a project to improve the public's perception of the United Nations.

It's become fashionable for creatives to be diverse, renaissance men and women, but Eliasson is conspicuous for his thinking and popular appeal. To put it crudely, he's done stuff you've heard of even if you're not interested in art, and his ideas about human thought and behaviour have relevance well beyond the gallery gift shop. Two million people experienced *The Weather Project*, and countless more admired the four man-made waterfalls he constructed in New York Harbour in 2008 and have enjoyed New York's Highline park, a project on whose committee he served. Having attended climate-change conferences with an Icelandic president, and collaborated with world-class scientists, as well as corporations such as BMW and Louis Vuitton, he mixes art with science, politics and commerce. This makes him well suited to a time in which, as Christie's head of contemporary art recently observed, entrepreneurs have become interested in "understanding the world through the eye of the artist".

He scorns the notion of the artist as visionary genius. "I like to take away the posture of the artist as some kind of mystical, divine world-shaper. I'm very sceptical about that idea," he says. "I am interested in the relationship between you and the artist. Because the artist makes no demand of you, does not try to sell to you, you feel you are co-producing your experience. Art, the creative

PHOTOGRAPHY: PARI DUKOVIC; TATE



Light-bulb collection

BERLIN STUDIO, 2015

What does a man obsessed with the nuances of light collect? Light bulbs, of course. Eliasson's Berlin studio is home to a wide array of lighting, from neon tubes to elaborate filaments. He often refers to objects such as these as "tools" or "machines" for producing certain psychological effects.

The Weather Project

2003

Perhaps more than any other piece, the Tate Modern Turbine Hall's *Weather Project* is responsible for Eliasson's high profile. It used 200 high-frequency lamps, a translucent semi-circular screen (doubled by a mirror), and mist machines. Visitors usually enjoyed it lying down.

Little Sun

2012

The solar-powered LED lamp was the first product by Eliasson and engineer Frederik Ottesen. The aim was to provide free light to the 1.2 billion people living "off-grid", using a work of art that would raise awareness. It is distributed in nine African countries and sold in Europe, the US and Japan.

> The idea was that owning a lamp would make customers consider where electricity came from and be an active part of the energy debate

muscle, is a trust machine. Some business is realising that, though the McKinsey machine [by which he means mainstream global corporations] has underestimated its power."

His interest in social contracts and our relationship with public space is key to his work, and comes partly, he says, from his upbringing in Denmark, where the civic life of the individual is taken seriously. He lives there with his wife, Marianne Krogh Jensen, an art historian, and their 11-year-old son and nine-year-old daughter, both of whom were adopted in Addis Ababa. Their house is just around the corner from the studio, formerly the home-studio of Jens Ferdinand Willumsen – a 19th and 20th century Danish artist, best-known for his symbolist and expressionist work – in the calm, affluent area of Hellerup on the northern edge of Copenhagen. This is his "contemplative" space, where he can "exercise, spend time with the kids, read and think"; for a couple of days each week, he commutes to his famous multi-disciplinary studio in Berlin, a four-storey "reality-producing machine" where he employs around 80 people, and the work is intense.

People who work with him say the secret to his extraordinary productivity is his interest in collaboration. He seems particularly interested in scientists and engineers: he worked with Einar Thorstein, Buckminster Fuller's former friend and colleague, on geometric structures, for example, and scientists from the Intergovernmental Panel on Climate Change when he brought ice from Greenland to melt in Copenhagen for a work dramatising a climate report. According to Felix Hallwachs, the executive director of Little Sun, who was previously director of the studio, "Olafur likes to extend his own abilities by finding people who can do things he doesn't have time for. He built the studio with people who are inspired by his thinking, but who also had their own visions."

Eliasson agrees. "I'm very curious to access fields in which I am less knowledgeable and see if the creative muscle can translate into action. I am very respectful of the people who are knowledgeable, and I say, 'I don't have an answer to the challenge, but I have a tool – it's called creativity.' As an artist, I think I can co-produce answers."

The studio, a tidy, airy, white chamber, evidences an unpredictable, eclectic but organised mind: experimental paintings, sketch pads, a random selection of stuffed owls, an electric guitar ("for when I can't stop my brain"), and neatly geometric brainstorming diagrams on the walls. Eliasson – designer specs, Asics trainers, basic black shirt and jeans – could be a cool, social democrat "star-cademic" from a Scandi-noir TV series. Well-read, and more given to abstraction and theory than human interest, he does not talk down to those he's addressing. In the first hour of conversation with WIRED he references philosphers Gilles Deleuze, William James, Bruno Latour, Evan Thompson and EB Holt, buddhist Matthieu Ricard, phenomenology, interpretive research, radical empiricism and gestalt theory.

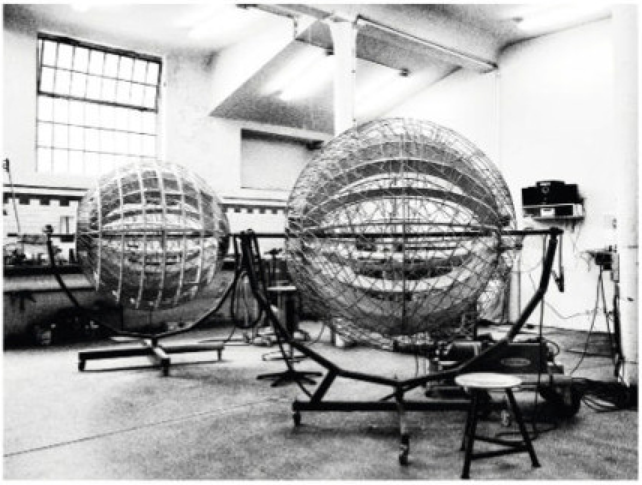
PHOTOGRAPHY: SUN LEE; PARI DUKOVIC

Little Sun

TRADE, NOT AID

The Little Sun company helps less developed economies by trading with them as partners, rather than making donations. It follows some key principles:

1. Give generous credit terms, not freebies.
2. Use western wealth to absorb more of the business risk.
3. Relieve commercial pressures by working with like-minded partners.
4. Don't donate – invest in lasting distribution networks.
5. Sell the same thing everywhere, but charge a premium in the west, which can help support the business elsewhere.



Unnamed project

2015

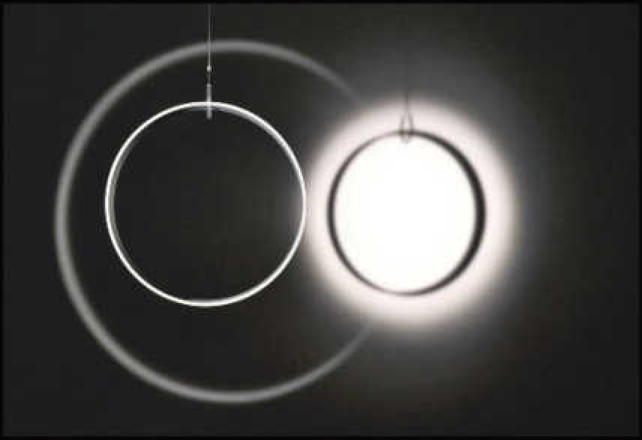
These metal spheres, each about a metre-and-a-half across, have been fabricated in the studio's metalwork shop. They are scale prototypes for an as-yet unnamed project.

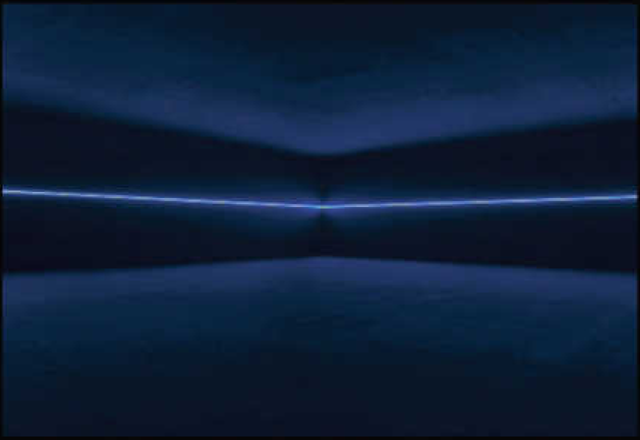
Eliasson developed the rechargeable lamp with his friend Frederik Ottesen, the engineer and "solar nerd" who works with Solar Flight, the California-based solar plane company. Ottesen guarantees they have the most effective solar tech; their army-grade panels convert up to 24 per cent of sunlight to stored energy; bottom-end kit might do as little as one per cent, which is why cheap garden lights from DIY stores are so dim. It was energy that Eliasson thought about when he was designing the lamp, beginning, as he often seems to, with a question like one a primary school teacher might ask a class: how did it feel to hold energy in your hand?

"It felt exciting," he says. "And possible." You were connected to everyone else in your ability to take free energy from light; you had your own mini-sun in which to store energy from the real one. He made the black box into Little Sun, a bright yellow star with a yellow lanyard, that worked both as a symbol and an object of desire. London's Tate Modern exhibited and sold it, department stores stocked it, and two years later Bloomberg Philanthropies had invested $5 million (£3.2m) in the Little Sun startup, which runs out of an office near the Berlin studio. The lamps are now sold by 250 museum shops at a higher price in "on-grid" areas, to support low-price sales by local agents to communities without electricity in eight African countries. Sales to date are more than 200,000.

This autumn, Little Sun, with the help of a crowdfunding campaign, launches its second product, a solar mobile-phone charger. People in Africa had asked Eliasson's team to make a charger for their next project: wireless penetration is more than 60 per cent and rising quickly as people use mobiles to overcome weak landline infrastructure, but lack of access to electricity means they must resort to expensive and inconvenient means of charging, such as adapted bicycle dynamos, and kiosks where you (over)pay to hook up a phone to a car battery for $1 (65p).

The Berlin studio is a converted brewery in the Mitte district, comprising workshops, a test space for new installations, an administration and archive area, an elegant, vegetarian refectory in whose kitchens all studio employees take turns to help, an architectural practice, and rows of desks with people working on various projects. The idea is that everyone helps everyone else. At one point, as one member of the team shows me a model of the Copenhagen harbour building to show how part of it will have no floor but just enclose some of the harbour water, people at one desk comment favourably on a set of page designs for the cookbook while, simultaneously, a group of people congratulate a designer on a new prototype Studio Olafur Eliasson website that imitates a black hole. The esoteric, creative



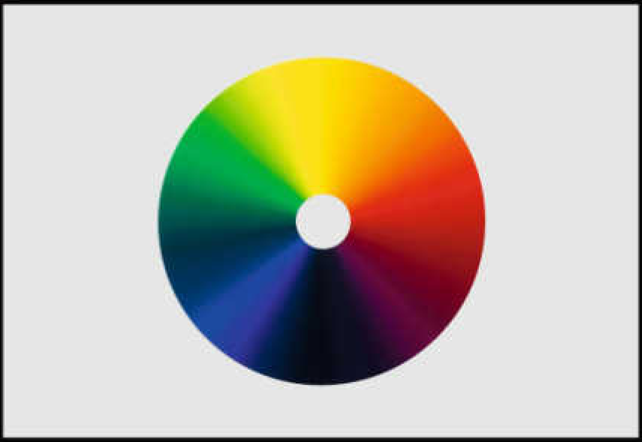


PHOTOGRAPHY: ANDERS SUNE BERG; JENS ZIEHE; CARL HENRIK TILLBERGS

Twenty years of Studio Olafur Eliasson

Opposite, left-right: *No Nights in Summer*, 1994; *9800054*, 1996; *Green River*, Moss, Norway, 1998; *360° Room for all Colours*, 2002; *Your Space Embracer*, 2004; *Your Black Horizon*, 2005; *Your Mobile Expectations*, 2006; *New York Waterfalls*, 2008

This page, left-right: *Grey Sheep*, 2009-present; Harpa Reykjavik concert hall, 2011; *Your Rainbow Panorama*, Denmark, 2011; *Infinite Colour Double Polyhedron Lamp*, 2011; *Emergent Fade, colour experiment no. 48*, 2012; *Riverbed*, 2014; *TYT* cookbook, 2015



discussions appear to contrast with what's happening in the workshop, where men pack pieces into crates. "Well, you can be actually pretty creative packing a crate! Seriously, you can," Hallwachs says.

In the middle of the building there's a studio, where Eliasson works and meets staff (on average they each get 10-15 minutes when he visits, the schedule tightly organised by assistant and "diarymeister" Florian). Among sketches, models and desks, this floor also houses Eliasson's extensive collection of vintage light bulbs, and a full-size archery target with arrows embedded in it. Sometimes, in order to make himself start work (Eliasson draws and conceptualises in the morning because he claims he is more focused then, and makes things in the afternoon), he shoots an arrow, first asking it a question: "Should he begin now, or delay?" Or, "Should he alter the size of a piece?" He takes a bullseye as a yes or a go-for-it, and if the answer's not what he wants, he shoots again until "the answers and I have synchronised".

Over lunch of roasted tomato salad, Hallwachs, a young, energetic German who trained as an architect, explains the thinking behind the phone charger. He and Eliasson believe it could make westerners think about energy even more than the lamp. "Because whereas you don't go out to buy a lamp often, you do buy replacement batteries and power packs for phones and, at home, most families are constantly charging devices, maybe ten or more. We take the power for granted, but if you can watch a solar charger draining, it makes it palpable." So in developed countries, it's not about energy saving *per se* (in Europe and the US it costs only about £7 to keep an iPhone, iPad and laptop charged for a whole year) but about using that great mini-ritual of device-charging to make us think. In the developing world, however, a cheap phone charger has vast potential: in terms of communication and information, mobile internet access is currently catapulting people to developed-world standards from a pre-mass-telephony age. It is as if someone had invented the mobile in Europe in 1920, but only the richest five per cent had electrical sockets.

"The lamp was a kind of a wedge in the door to open up talking about energy access," Hallwachs says, "but the target for us is to make a big step in Africa because the charger is required, and in the global north, because it opens the discussion of energy in a palpable way." The chargers will be sold through the existing networks, supplied on generous credit terms rather than discounted because, in the 21st century, African distributors want a proper trading relationship rather than charity. At the time of going to press, their design was unfinished – it will be "shiny and maybe a little bling", according to Eliasson, the feeling being that "this is my own remote power plant, and with this I can power myself."

On defining creativity

Eliasson thinks that "the most common definition of creativity, ie, being unpredictable," is "an unfair simplification." Creativity, he says, "very often comes down to being confident that a task is worthwhile. It isn't so much in the doing, as in what motivated you."

The art of the ordinary

Eliasson's work is rooted in both philosophy and the everyday. Among his inspirations, he lists:

Breakdancing
Hiking
Power cuts
Weather
Town planning
Nightclubs
Reading by torchlight
Food
Pop music

When Eliasson's parents Elias Hjörleifsson and Ingibjörg Olafsdottir, two 21-year-old Icelanders, moved to Copenhagen, he had just been born. Hjörleifsson's family belonged to Reykjavik's small Bohemian arts set, his father a publisher and his mother a photographer. Olafsdottir was from left-wing fishing stock; in the 60s and 70s her father, a communist trawlerman, used to sail across the North Sea to visit the communist German Democratic Republic. In Copenhagen, Olafsdottir worked as a seamstress, Hjörleifsson as a cook.

They struggled financially, though while Olafsdottir "worked her arse off," tells Eliasson, Hjörleifsson was more interested in his art; in the early 70s they divorced, Olafsdottir subsequently marrying a stockbroker and moving to a farmhouse just outside the city. Eliasson lived with his mum and stepfather, and spent occasional weekends with his father in his art studio in his spare time. These visits to his father are the strongest childhood memories. "As my father was an artist, and I wanted him to like me, I took the drawings I had made throughout the week. And I over-performed in drawing; by the time I was nine, I could draw all the bones in the hand." Five years later, it was every bone in the body, executed with a remarkable photorealist accuracy.

> One day, in Copenhagen, he saw a fellow teenager moving like a robot. 'It was one of my epiphanies. From that minute on, I did everything like a robot'

In the summer holidays, the young Eliasson visited his grandparents – and later his father, after he returned in the late 70s – in Iceland, and his experience of its unique landscape would later be a huge influence on his work. It was here he learned the power of defamiliarisation – the feeling you have when seeing things presented in a surprising way that makes you feel you're seeing them for the first time. He has said that, because the Icelandic landscape is unique and under-represented in art, his responses to it were rawer and less-preconditioned that they would have been to, say, the Alps or a European pastoral setting.

Here, too, he learned the effects of weather and light. Because of the latitude, shadows are long most of the time and "everything is such a drama", he explains. Eliasson has a particularly strong memory of the Icelandic twilight, and it is not difficult to see that in works such as *The Weather Project* or *Your Rainbow Panorama*. "During the oil crisis in the early 70s, he recalls, "there was an embargo on the use of oil, and at 8 o'clock every night the government turned off the power. After cooking a meal, you would hear the city bell ring and then all the power turned off, and people moved everything they did in the house to the windows, because it was still light outside. I was five or six years old, so I remember very well that we took our books, magazines, toys, games to sit in the windows with that blue light. It was very beautiful, and this blue light from the twilight of the Icelandic midnight became a very strong influence for me."

His childhood influences are not all about nature and Scandinavian civic values, however. Interviewers often point out that, in 1984, performing as part of a trio called Harlem Gun Crew, he won a Scandinavian breakdance championship. They tend to present this as a quirky aberration but, as he explains, the dancing contributed to his art. Aged 15 he was quiet, heavily into drawing, a nerdy country kid. Then, one day in Copenhagen, he saw a fellow teenager on the street, moving like a robot. "It was one of my epiphanies," he says. "Immediately, from that minute on, I did everything like a robot. Pouring milk on my cornflakes, riding my bike to school – which is actually very difficult because of the circular motion of the wheel – everything, I did it like a robot; every movement on a 90-degree angle."

One Way Colour Tunnel

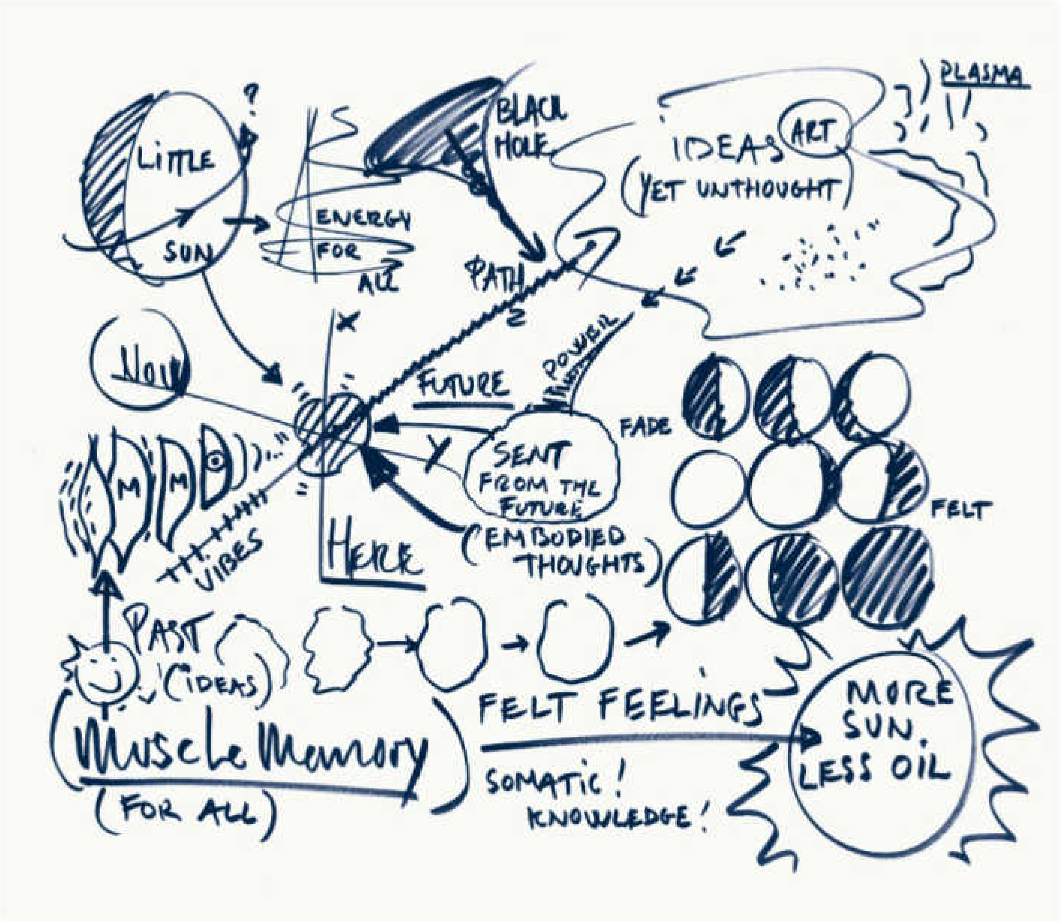
2007

This ten-metre-long passageway is made from steel, colour-effect acrylic glass and mirror, and black paint. Walk through it one way, and you get a kaleidoscope of colours; turn and walk back through, and the panels turn black.

Olafur Eliasson for WIRED

2015

Many critics comment on the scope and variety of Eliasson's projects, which range from weather-based installations to flocks of sheep in Iceland. Eliasson says that for him, the strands are always connected – and to prove it, he drew this mind map illustrating how just a few link up.



Olafur cut and dyed his hair to look like Limahl from Kajagoogoo ("quite brilliantly"), and went to the local disco where he stood alone on the dance floor and did the dance. He had no idea that anyone else had thought of doing it to music. "I wasn't connected to a dance scene! I was just like, Country Robot. And then this other guy came along and danced like it, and he explained that what we were doing was related. I said, 'Oh, no it isn't! I don't know what you're doing, but I'm a robot…' Anyway, we became friends and met another guy whose mum had a dance school. My mum made us silver costumes, and I became famous as an insane robot. I had a nice 'freeze' movement."

He relates all this in his studio, in the same thoughtful, "Scandillectual" tone of voice he uses for everything – philosophy, climate change, the open ryebread sandwiches he orders in for our lunch. The dancing, he continues, "gave me a body that I could connect with the drawing I had done. And being able to express myself, and to be part of a youth culture, gave me great confidence." When he began art school – his father, who had been suffering from alcoholism, helped with the application – he was drawn to installation art, which then led to architecture. Had he not danced, he would "not have had that interest in the way people and light work in spaces. And also, I wanted to be as successful at school as I was at the dancing."

The conversation moves on. He talks about research, and how he sees more interesting, challenging work being done in the private sector than in academia; about our age's discovery that accessing more data leads people to take less, rather than more action; about how the most creative, educative part of a project for him is the process of actual, hands-on making, "Because that's when I learn. But there is an interesting moment of fear, especially when you feel afraid that starting something could bring you failure. You can end up talking about something you want to do, as if talking about it is the same as doing it, and because it allows you to test it out on others. You can have a full night in the bar, talking about everything you want to do, and you wake up with the feeling that you've done it because you cashed in on all the appreciation already. And the next day, you find the cashing in took away the momentum."

This loops back to the Little Sun. One could ask if this isn't all just intellectualised Fisher-Price trickery but, in the context of debates about climate change and the environment, the answer would have to be no. The big problem for campaigners has always been intangibility. Something you can neither see nor feel is hard to think about and easy to ignore; religion is helped by its icons and ritual, whereas environmentalists must rely on over-familiar, depressing footage of melting ice caps and denuded rainforest. The Little Sun demonstrated an optimistic belief in renewable energy that allowed anyone to buy into it, and feel part of a movement. As a tactic, it offers a route for anyone promoting an intangible technology, a service or a campaign, or tackling a social problem: how do you put something inspiring into people's hands that both represents, and is part of, a solution?

Hallwachs cannot imagine the project without the artistic element; there is little chance, he says, that they would have had the idea without it. Fundamental to Eliasson's work is the belief, rooted in phenomenology and gestalt psychology, that in changing an individuals' perception of their surroundings, art actually changes the world. The studio is based on a shared conviction on art and creativity as means of change, and "because we are looking at things from an artistic angle, we consider things relevant that other people would not. The combination of business, design, global activism, a movement, lobbying comes from the artistic perspective. If there was no art involved, it would not only be a different project – we would not have started it in the first place." ▣

Richard Benson is a journalist and critic, based in London and Yorkshire, and author of The Valley *(Bloomsbury Publishing)*

How IKEA designs

WIRED DESIGN 2015

Left: IKEA designer Ida Pettersson experiments with collage to create textile patterns
Right: a new chair in the steel prototyping area of IKEA's Älmhult campus

FROM 3D-PRINTED CHAIRS TO EVOLVED KITCHENS, THE WORLD'S BIGGEST FURNITURE RETAILER IS REASSEMBLING THE FUTURE. WIRED VISITS ITS LABS IN SWEDEN AND SHANGHAI

BY JONATHAN BELL **PHOTOGRAPHY:** CHRISTOFFER RUDQUIST

> ALL MANUFACTURING BUSINESSES LIVE IN THE NEAR FUTURE.

Supply and demand are predicated on getting the balances just right, making sure factories fulfil existing orders, avoiding excessive surplus, and that someone, somewhere, is stimulating demand for new stock. IKEA sits atop one of the most sophisticated and efficient supply chains in the world. The Swedish furniture giant is a logistical titan, a multi-billion-euro business – sales across the globe between September 2013 and August 2014 were €29.3 billion (£20.9bn) – that owes its success to the relentless pursuit of the margin, eking out efficiencies in every part of its vast and disparate corporate structure.

Älmhult, in southern Sweden, is IKEA's spiritual home. Company founder Ingvar Kamprad opened the first IKEA store here in 1958, turning his burgeoning mail-order business into a bricks and mortar outpost. Served by a modest railway station about an hour's drive from Malmö, Älmhult lies in low, forested hills, a landscape of baked red cabins with white trim and neat lawns. The original IKEA building is still there, buried in six decades of accreted industrial structures and offices, and is in the process of being turned into a museum. The town, which has a population of less than 10,000, is at the heart of a company that claims not to have a dedicated HQ or flagship location, and which remains under the control of the Kamprad family.

IKEA is logistics – a manifestation of the early-twentieth-century obsession with time, motion, efficiency, supply and demand. Frederick Winslow Taylor, American pioneer of "time and motion" management theory, could scarcely have predicted IKEA's seamless translation of efficiency into profit. For the IKEA method doesn't just apply to the various ways it designs, manufactures, markets and distributes its products, but to the opaquely structured web of corporations, franchises and foundations that control the company, maximising the flow of capital back into the blue and yellow coffers.

There are 370 IKEA stores in 47 countries. The next big target is India, where a period of intense market research and product development is currently underway. The IKEA Industry Group, the manufacturing arm of the business, has 44 production units scattered around 11 countries, supplying not just the parent company but others as well. It's here that the magic happens, and that the fabled efficiencies and capacity are exploited to the full to keep the golden tenet of the business relevant and viable: a low price. More than half of production happens in Europe, with infrastructure that runs from planting trees through to processing the raw materials that make the furniture. IKEA currently has 1,046 suppliers, necessary to service a product range that hovers at around 9,500, with every item specifically created for the company and christened with crisply guttural Scandinavian functionalism.

Älmhult is also home to the IKEA design department, overseen by design manager Marcus Engman, a true company man. He holds the same post his father once did, and his mother and wife were also both IKEA employees. In 2012, after a decade in private practice – "external education", in IKEA speak – Engman returned. Grey-haired and boyish, Engman explains IKEA's approach with a gentle bemusement at the suggestion there is any other way.

Today, the department has its own building on the Älmhult campus and a new building and designation – the IKEA Democratic Design Centre – where 20 in-house designers work for Engman. They collaborate closely with IKEA's design centres in India and China, each assembled to combine on the spot information with the IKEA approach. As a result, there's plenty of cross-pollination between the three studios, with the two satellites serving up vital local knowledge about taste, technology and materials. Each feels like an IKEA store of the future, a gallery of as-yet-unseen products and new materials without price tags or customers – the equivalent of walking into a newsagent and finding every magazine datelined January 2017.

The design team works on around 2,000 new products every year, assisted by up to 75 freelancers and bigger names brought in for one-off projects, such as a planned 2016 line with fashion designer Walter Van Beirendonck. A similar quantity of products is refreshed and enhanced. This is retail evolution at its purest: the strongest sellers survive; others evolve to meet demand and fashion; and the weakest are culled. The most efficient place to save money is in the manufacturing process, hence this campus-sized facility dedicated to shaving every last millimetre of material to its optimal size, exploiting the latest in material advances and finding new, faster and simpler ways of putting together furniture. Furniture that, ultimately, has to be put together by its purchaser.

Walk into any IKEA and you're assaulted by novelty. By the time you wind your way through to the distant checkout, you will have traversed a landscape of modern domesticity, drunk on choice and dazed by price tags. Engman knows his constraints. For a start, the physical experience of the store can't change. "We need to keep each department the same size, with the same number of articles," he says, "but we change according to consumer behaviour." This means reams and reams of data and analysis. "We start with consumer insights, usually from home visits," Engman says. These home visits have most recently arrived in China, where designers pad around family homes, inspecting the storage and asking how IKEA might make an impact. On top of that, the other driver is capacity. "We also look for the value chain and our existing production capacity," he says, explaining how the aim is to run every production line at maximum efficiency. It's these pockets of potential that often inspire new ideas.

"We start with 200 to 300 ideas, then cut to 35 – we are constantly discussing how things evolve," says Engman. But the core beliefs are immutable. "The identity of our range should be the same all over the world." Typically, this approach

1. IKEA'S HEAD OF DESIGN

Marcus Engman is design manager at IKEA, based at the Älmhult campus in Sweden. Behind him is a Vilbert Dinner Chair, designed in the 90s for IKEA by Verner Panton – it's now considered a collector's item.

2. CHEMICAL SAFETY TESTING

A scientist in IKEA's Shanghai laboratory tests a batch of new dyes to ensure they meet global health and safety regulations.

3. COLLABORATIVE DESIGN

IKEA designers pay a visit to a bamboo supplier in Hangzhou, where they discuss potential new products with the manufacturer.

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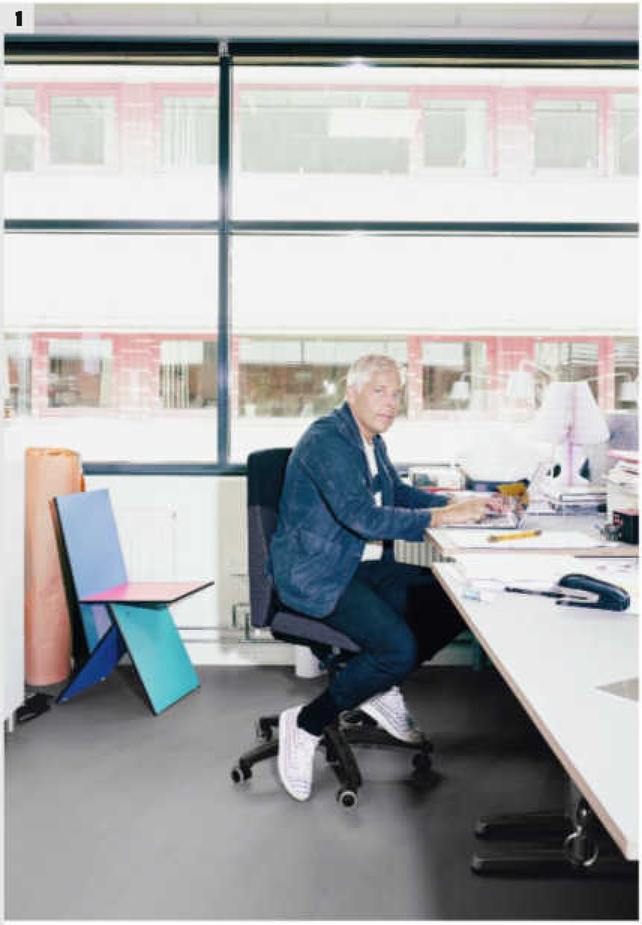

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HOW IKEA AND IDEO RETHOUGHT THE KITCHEN

The IKEA Concept Kitchen 2025 was developed with IDEO and two leading European design schools, the Ingvar Kamprad Design Centre at Lund University, and the Industrial Design department at Eindhoven University of Technology. Gerry Dufresne, IKEA's kitchen strategist, says the brief asked a simple question: "What will be our behaviour around food in 2025?"

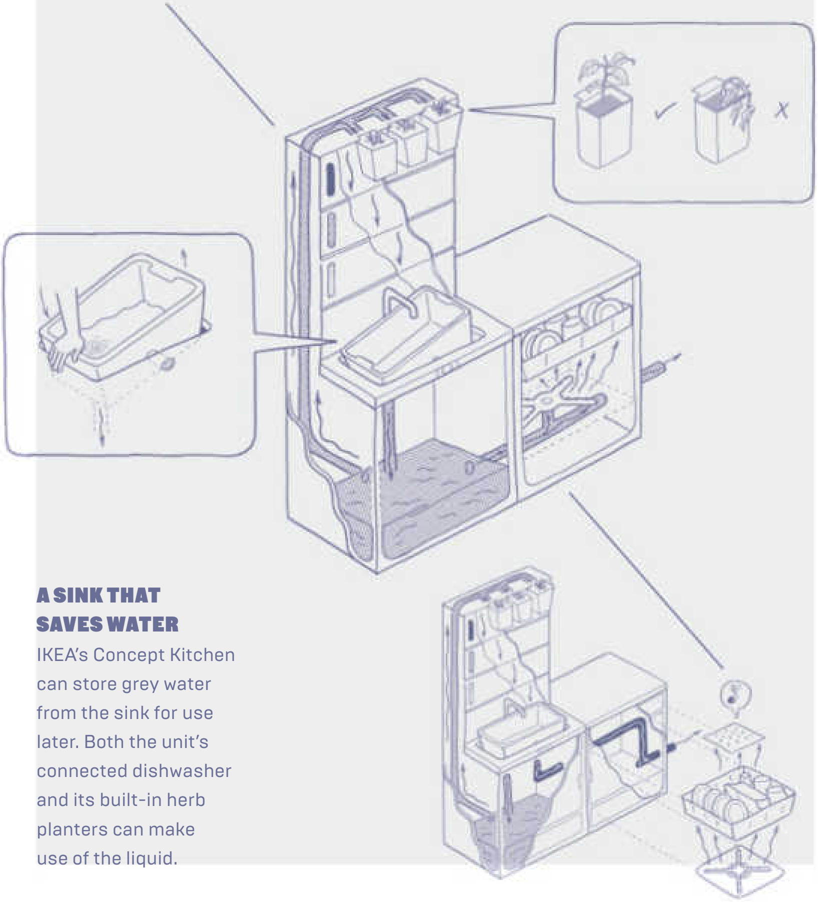
IKEA's kitchen is not so far from the ideas of Margarete Schütte-Lihotzky's 1926 Frankfurt Kitchen, or the Whirlpool Miracle Kitchen of 1956. The intensive research period – overseen by IDEO – came up with ideas about food storage, presentation and eating itself. The result is a hybrid of ideas and materials. "We usually work three to four years ahead, but this project was planned as an aspiration to ourselves," Dufresne says.

Ideas include a Mindful Water System to separate toxic (black) water from recyclable grey water, and a more interactive waste disposal system to promote recycling. Storage is given a particular push. "Fridges are all wrong – how can you improve vegetable storage?" Dufresne asks. The solution is low-tech: a pantry that places food on display rather than hides it away to be forgotten.

The company is also reading deeply into the shifts in diet and behaviour. "There are changing relationships with food – waste, nutrition, buying habits. Our consumers live in big cities with 24-hour supermarkets, so purchasing habits change," Dufresne says.

The kitchen's Table for Living (TFL) is particularly interesting. Replacing the typical slab of IKEA laminate, the TFL is a multi-modal surface with embedded induction coils, so food can be prepared and cooked in one area. It also scratches the futurist itch of interaction, with cameras and software designed to recognise ingredients and make suggestions.

"Design is about managing constraints in the best possible way," explains IDEO designer Juho Parviainen, from the company's Clerkenwell studios, who ran the project. "The kitchen explored the future through actual making, rather than just commissioning and reading reports."



Grey water from, say, washing vegetables, can be recycled to water herbs

A SINK THAT SAVES WATER

IKEA's Concept Kitchen can store grey water from the sink for use later. Both the unit's connected dishwasher and its built-in herb planters can make use of the liquid.

ends up flattening cultural differences, finding the best way of making what might be a relatively indigenous object and then transforming it into a global product. "We had to have a wok in China, although it was not a typically Scandinavian product," Engman says, "so we take those learnings and spread them around the world." Similarly, in India, where IKEA will shortly be opening its first store in Hyderabad, Engman explains that there is a much larger demand for low-price items. "In our vision we have to reach as many people as possible. We're looking for similarities as well as differences, because that means volumes, which in turn means low prices." Expansion means taking the time to understand new markets. Early forays into North America faltered due to cultural differences. According to *Fortune*, Americans bought vast quantities of flower vases but used them as tumblers, as the Swedish glasses were too small for ice-filled drinks – an object-lesson in the value of good research.

The first UK IKEA store opened in Warrington in 1987, injecting stripped-back simplicity into a nation that was groaning under the weight of traditionalist furniture. The 80s are often cited as the designer decade, thanks to the advent of a masculine aesthetic of matt black, chrome and shiny push-button technology. Yet these were metropolitan ideals, clearly distinct from the soft-furnishing world dominated by big warehouse operations such as DFS. By 1996, IKEA UK was bold enough to launch its "Chuck Out Your Chintz" campaign, which encouraged disposal of great swathes of fringed furnishings in favour of the clean and self-evidently superior Scandinavian alternative.

Chuck Out Your Chintz let IKEA tap into a parsimonious streak of British culture that can be traced back to the days of William Morris. "Good" design – objects that are innately morally wholesome or beneficial, with embodied craft or functional supremacy – is periodically touted as an antidote to a lethargic, overstuffed and reactionary culture. The exhor-

4. TESTED TO DESTRUCTION

IKEA's candles undergo testing in the Shanghai lab. Here, a selection of tea lights is left to burn to check they do not become dangerously hot and break their glass holders, and to measure soot emissions.

5. WOOD PROTOTYPING

A large part of the sprawling Älmhult facility is given over to workshops for experimenting with prototypes and new methods of assembly. These tools enable design and creation in the same space

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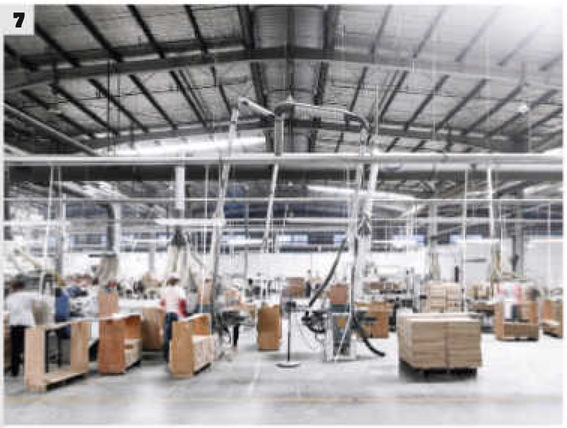

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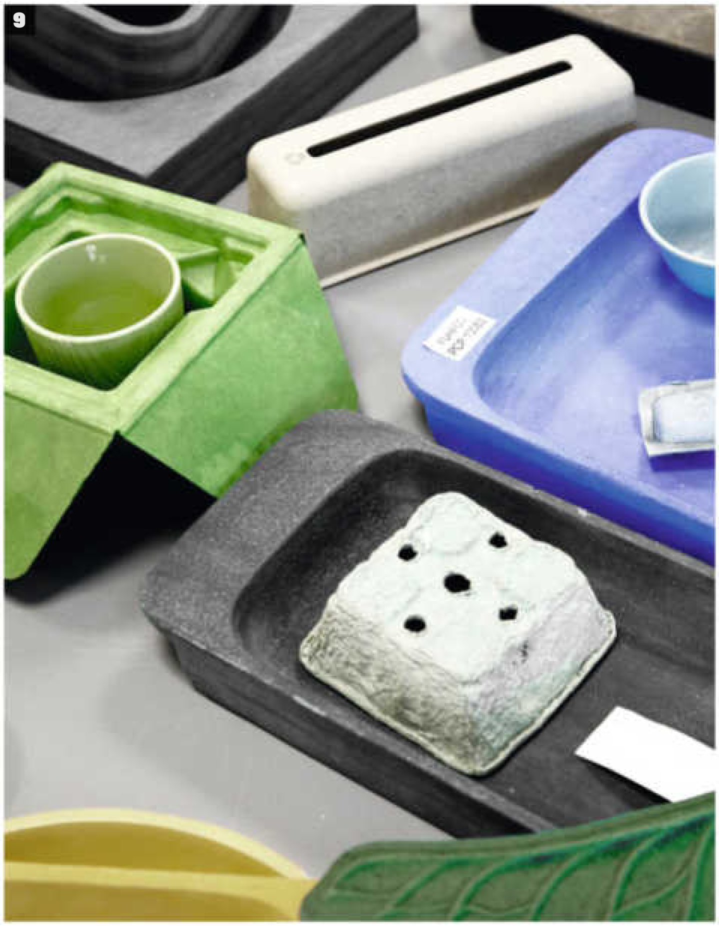

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6. MECHANICAL QUALITY TESTING
In IKEA's Shanghai Design Centre, a hydraulic simulator recreates the impact of sitting on the edge of a MINNEN bed, getting up, and sitting back down. It can quickly replicate a lifetime's intensive use.

7. CHINESE BAMBOO FACTORY
Workers on an assembly line in Hangzhou prepare bamboo sections. IKEA's designers work on-site with the supplier to iterate current products and try out new ones as soon as they're created.

8. IN-HOUSE TEXTILE DESIGN
Ida Pettersson, design project employee at IKEA, Sweden, checks bolts of printed cloth bearing prototype patterns. They are based on her paper collages (*see feature opening image*).

9. EXPERIMENTAL PAPER PRODUCTS
IKEA is famous for its use of materials such as laminated particle board. However, in a drive to use more recycled material – and reduce costs – paper is being explored as an alternative. Here, designer Ida Pettersson has grouped an array of items made from paper pulp, in a variety of experimental colours and finishes.

10. LEARNING FROM REAL LIFE
A group of designers from Sweden pays a visit to a family in Hangzhou. They are researching the types of furniture a typical home in China contains; how much storage there is and of what kind; the diversity of items that can be found from room to room and what they are used for; and – most importantly – how IKEA might fit in.

tation to chuck out one's chintz was a modern retelling of the post-war drive for functional simplicity in furniture and home goods, an officially sanctioned programme under the auspices of the Council of Industrial Design – now the Design Council.

Then, as now, the design industry imbued products with characteristics that reflect our personalities, ambitions and aspirations. IKEA's stripped-back Scandinavian style was deemed symbolic of a more progressive, modern, caring Britain. Even the inexorable rise of the casual sofa as a focal point of the home was partly driven by IKEA's ruthless pricing. "The IKEA sofa was disposable furniture for urban nomads and serial monogamists," wrote Joe Moran in his social history *Queuing for Beginners*. "It was light, unfussy and stylishly impermanent, with none of the baggage of the family heirloom or the bought-for-life wedding present."

The spinning wheel of fashion has brought pattern and colour back into our soft furnishings, be it the retro geometry of Orla Kiely or the naked revivalism of Cath Kidston; IKEA would be insane to ignore it. Today, the company's product ranges are divided into four style groups: Scandinavian Modern; Scandinavian Traditional; Popular Modern; and Popular Traditional. "We have more modern than traditional," Engman says, but adds the division isn't as stark as it once was. "We go into each product with an extremely open mind."

Teams aren't just made of designers. Range strategists analyse future trends and set palettes. Technical co-ordinators liaise with production facilities. And designers exploit every facility in the building to find the best solution. The IKEA of today is more receptive to outside ideas than before. The concept product is now an accepted part of the modern manufacturing landscape, a canny synthesis of market research, public relations and design experimentation. The motor industry has used concept cars for decades, not just to gauge public opinion but also to preview new features and forms. Anyone with access to a copy of design software Rhinoceros and some modelling skills can whip up a convincing image of a next-generation smartphone or superyacht and set the internet abuzz for a few minutes.

IKEA has kept its futurist leanings to itself up to now, preferring its customers to live in a present where they can buy what they see. However, its Concept Kitchen 2025 project, initiated with IDEO (*see previous spread*), is a first foray into a more speculative strategy. A company that claims more than two billion combined store and site visits every year and distributes 217 million copies of its annual catalogue is sitting on some big data and statistics – 12.8 million mattresses and eight million BILLY bookcases sold in the UK alone as of 2012.

Up until now, the flow of information has been very one-sided, but a future in which customers talk back, consciously or not, could have huge ramifications in a business that's relentlessly driven with honing the margins. To predict is to innovate. To understand psychology is to have even more of an advantage.

The Concept Kitchen 2025 was a popular display at Milan's Salone di Mobile. Steeped in embodied technology, it had a crude appearance, with modular elements – a sort of culinary Black+Decker Workmate. Rough prototypes were made at IDEO in London, then refined at the Älmhult workshops. "It was super important that what we showed in Milan removed all sorts of style. We almost wanted it to look like a printed prototype," says IKEA kitchen strategist Gerry Dufresne.

IKEA is a machine for making. "We like physical prototypes,' says Engman. "We do rough ones very early – dirty prototypes – in our workshop. This all enhances IKEA's evolutionary advantage. "You have to innovate in the way things are put together," he continues. "Fittings are about 30 per cent to 50 per cent of the cost of the product, so could we create products without any fittings?" One prototype is a wedge dowel, a fixtureless fitting that allows table and chair legs to be slotted together with a twist.

Henrik Holmberg is head of department at the IKEA Model Workshop. He oversees a staff of 14, dedicated to "moving ideas forward into physical samples", using a vast array of tools and processes across five departments: 3D printing, upholstery, wood, metal and surface treatment. The challenges presented by IKEA furniture are very singular – can it be packed flat, transported, assembled, used and potentially dissembled again? According to Holmberg the workshop gets some 2,000 tasks a year, of which approximately half go through its four 3D printers. The biggest of these – a Fortus 900MC – has a build space that allows whole chairs to be prototyped.

Cost, inevitably, is at the heart of the process. Even the properties of paper are being explored through innovations such as M-board, a lightweight structural sheet made of 90 per cent recycled paper and formed on a short production line. In time, paper-based materials will form more and more of the constructed heart of IKEA's product lines. "To design some of these items you have to have your own factory," a pragmatic Engman says. "IKEA is about designing on the factory floor – what processes and situations they have at hand," IDEO designer Juho Parviainen, a former IKEA staffer, confirms.

Only factory-led design can fulfil the IKEA ethos. "Democratic design is an impossible formula to achieve," says Marcus Engman. "An object with great form and function that ages beautifully and is sustainable – then top that off with a low price. There are no short cuts to achieving that". IKEA has mastered the art of modern design without ideological baggage, and has a strong sense of the social utility of the company as a whole, not just the undeniable value and sheer consistency of its products. Yet its big-box model won't live forever in the urban plan of the future, at least in the west, so expansion is dependent on maintaining the urban status quo in the developing world.

From supplier to production line to pallet and distribution, IKEA is chasing margins through research and analysis. But as data becomes easier to capture and richer in meaning, the company could find itself with a stake in the domestic realm that's just as powerful as the search engines' knowledge of our desires, frustrations and obsessions. To survive and grow, IKEA must determine what we need and want just like any other retailer – through a network of focus groups, trend forecasters, customer clinics, futurologists, and good old-fashioned instinct. The evolutionary advantage stays with the strong. This behemoth of the flat-pack will do everything to stay ahead.

Jonathan Bell is editor at large at Wallpaper *magazine*

11. TEST LAB AND TRAINING CENTRE

The first IKEA-owned test lab outside Sweden, the IKEA Test Lab and Training Centre (ITTC) in Shanghai is responsible for quality, production and verification testing of IKEA products. This includes packaging, furniture and textiles.

12. MATERIALS LIBRARY

At the Democratic Design Centre in Älmhult, a reference library of materials, colours and textures is used to ensure new designs speak the IKEA "language", and that they sit within their particular category.

11

12

BY OLIVER FRANKLIN-WALLIS

PHOTOGRAPHY: DAVID VINTINER

THE BBC IS GIVING SCHOOLS A MILLION OF THESE FREE COMPUTERS.

IT HOPES IT WILL KICK-START A CODING REVIVAL. UNLESS POLITICS GETS IN THE WAY...

IT'S 9.30 ON A CLOUDY MORNING IN JUNE, AND IN AN IT CLASSROOM OVERLOOKING THE PLAYGROUND AT WINTERTON COMMUNITY ACADEMY IN SCUNTHORPE, A GROUP OF YEAR 7s IS LEARNING HOW TO CODE.

Twenty-four excitable students sit around the school's RM One PCs playing Flash games online before the teacher, Mark Sidell, sets them to work in Blockly, a visual programming language. The kids begin piecing together bricks of code like LEGO ("if x, do y"; "repeat") and testing it using an on-screen simulator.

Since changes to the curriculum in September 2014 – when coding and computer science were brought in to replace the failing ICT curriculum – this has been a common sight in UK classrooms. This morning, however, is no ordinary class. Winterton has been selected as part of a pilot for a BBC project launching this month that has the potential to transform computing education. On each student's screen is the image of a small computer, the front of which has two buttons and a grid of LEDs. Catherine, 12, is using it to write her name in lights. She drags a brick across her screen and a letter "C" starts flashing on the display. One girl has a pulsing heart flashing.

Nearby, a group of children plays with the device: a 4cm by 5cm single-board computer, which looks like a slightly smaller, black Raspberry Pi. When a button's pressed, text scrolls across the screen: "hello i am microbit". Developed by the BBC in partnership with companies including ARM, Microsoft and Samsung, the device is designed to introduce kids used to sealed-off smartphones and consoles to the basics of computer science.

Right now, Winterton possesses some of the first micro:bits in existence. But in September, the device will be given, free, to every student starting secondary school in the UK – that's around a million computers. The aim? To inspire a new generation to experience technology in a way that Britain hasn't known since the 80s.

* * *

On January 11, 1982, a new TV series called *The Computer Programme* aired on BBC Two. The first episode – an introduction to the new idea of "microcomputers", sandwiched in a mid-afternoon slot between a documentary on Kayapo Indians and a Humphrey Bogart film – marked a significant moment for British computing: the screen debut of the BBC Micro. Built by Cambridge-based Acorn Computing, the machine was to be the centrepiece of the corporation's ambitious Computer Literacy Project.

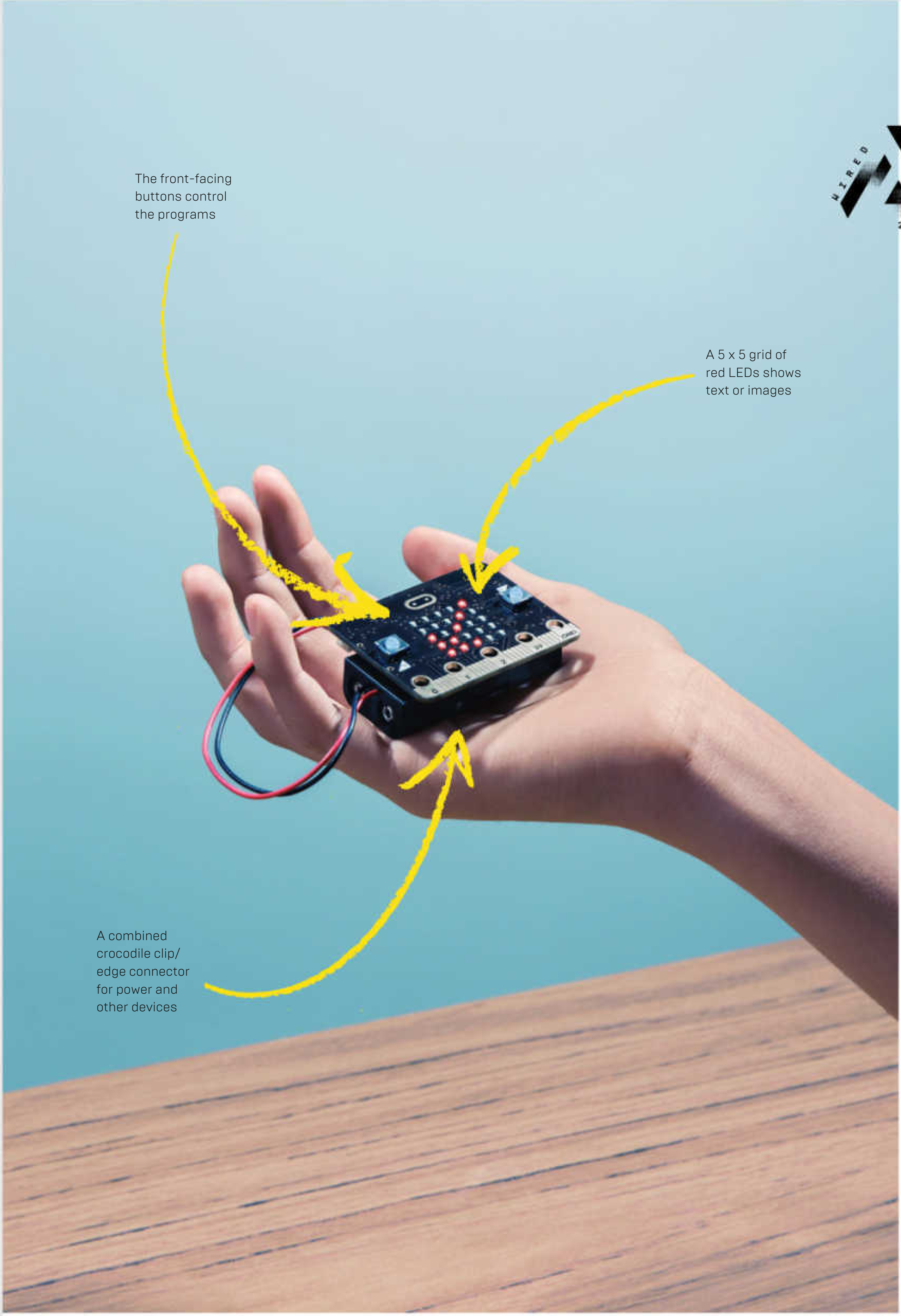
"The BBC, in its wisdom, decided to educate the people about the coming computer revolution," recalls Hermann Hauser, co-founder of Acorn. "And they concluded at the time that the only way they could educate the nation was by providing a computer they could actually try things on."

The Computer Literacy Project was a nationwide initiative, backed by the Department of Education and Science. "The model was the Adult Literacy Campaign, which had happened in the early 70s," says David Allen, the producer of *The Computer Programme*, who was instrumental in developing the Micro. "Everyone was talking about the microprocessor revolution. There was a huge threat to employment predicted."

A beige, 8-bit machine with an impressive 4MHz processor, colour graphics and seven connectivity ports, the Micro came with its own BBC BASIC operating system, designed to be easy for beginners to use. "It was very expensive," says David Braben, founder of Frontier Developments and co-creator of the bestselling BBC game *Elite*. (The lower-spec Model A Micro sold for £299, compared to £125 for the rival Sinclair ZX Spectrum.) "But it was an incredibly capable machine." The Micro was a hit, selling more than 1.5 million units, and *The Computer*

The micro:bit is designed to show off its circuitry, to teach children how hardware works

PHOTOGRAPHY: ROGER STILLMAN



The front-facing buttons control the programs

A 5 x 5 grid of red LEDs shows text or images

A combined crocodile clip/ edge connector for power and other devices

Programme was soon followed by instructional shows, *Making The Most Of The Micro* and the popular *Micro Live*, in which presenters demonstrated how to program the Micro and use it for everyday tasks.

"It was unimaginable. I mean, it was just incredible," Hauser, now 66, says. "We had so many hundreds of thousands of letters and telephone calls, we ended up taking over Sunday morning on BBC One," says Allen.

With government support, an estimated 60 per cent of UK primary schools and 85 per cent of secondary schools adopted the Micro. A generation of children took IT lessons using BBC BASIC. "It was very easy to program," Braben says. "You could be programming within a second of turning it on. It went 'beep beep' and it was working, and you could type '10 PRINT DAVID, 20 GO TO 10' and you had your first program written in five seconds. Even if you made a mistake and it all went wrong, you pressed the Break key and it would go back to the start. It was very good for learning."

The Micro and the Computer Literacy Project had a transformative impact on Britain's IT skill base. Acorn would give rise to the semiconductor giant ARM, whose processors are in most tablets and smartphones. Many entrepreneurs, including Autonomy founder Mike Lynch and the team behind the Raspberry Pi, have cited the Micro as pivotal to their success. "My whole career was down to the BBC Micro," Lynch says. "It was my only access to a programmable computer and great training at a fundamental level."

But the advent of Windows PCs in the 90s changed computing education in schools. Kids who once had to learn the fundamentals of computer science – how a computer works, not just how to work it – began to be trained only to use Office software.

"The big change which happened, I believe around 1999, was that computer science was replaced with ICT [information communications technology] – which wasn't a specialist subject. That means the teachers didn't need training. So ICT was being taught by PE teachers and DT [design and technology] teachers," Braben says.

"The curriculum changed from teaching kids how to program in BASIC to using Word. They lost the ability to program," Hauser says. "I remember computer departments complaining to me that nobody knew how to program any more."

The BBC Micro Model B, which was first produced in December 1981

"Computer science as a subject just slid into disrepair," remembers Simon Peyton Jones, chair of the education group Computing At School. "Because everybody used computers, some head teachers would think: 'ICT, it's just about spreadsheets and word processing, isn't it?' It became a very low-status subject, and very deskilled."

Those changes had a huge impact on the UK's computing education: in the decade after 2001, the number of students taking computing- and ICT-based GCSEs and A levels fell significantly. In August 2011, Google's Eric Schmidt gave a MacTaggart Lecture criticising the state of British computing education, accusing the UK of "throwing away" its computing heritage. Meanwhile, a group of professors at the University of Cambridge, noticing a decline in both the number and quality of applicants for computer-science degrees, decided to do something. They set out to develop a cheap, credit-card-sized computer called the Raspberry Pi, which they hoped would become the BBC Micro for a new generation. They even approached the BBC to suggest calling it the BBC Nano.

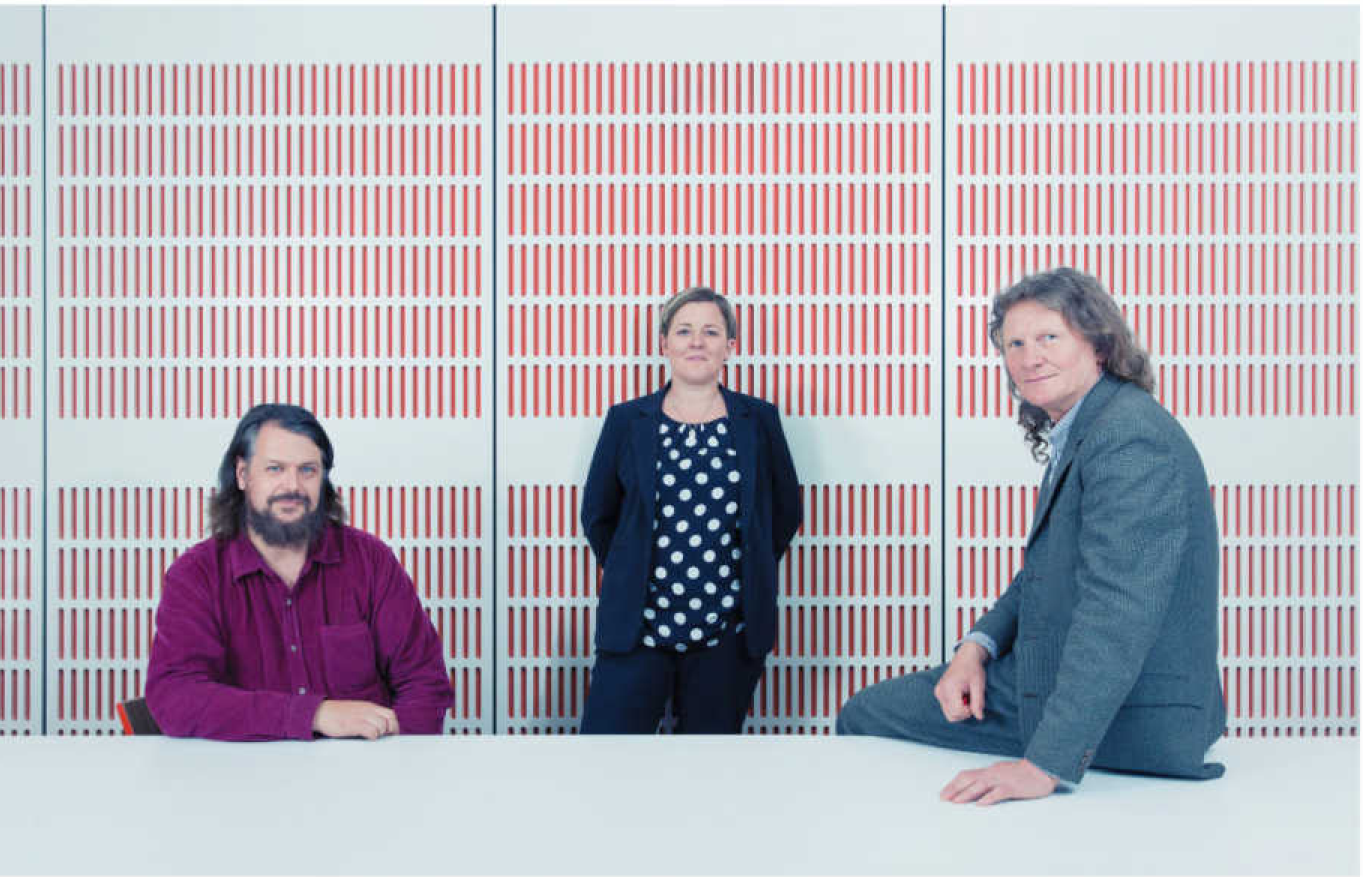
"We talked to a lot of people at the BBC," says Eben Upton, a co-founder and now CEO of Raspberry Pi. "The guidance we got was: this is very hard. It's hard for an organisation like the BBC now to do what it did in the 80s and endorse a third-party platform."

The BBC's trepidation was unsurprising: in 2007, the organisation had been forced to close BBC Jam, a free digital-education portal, after rivals complained to the European Commission. The fiasco cost up to £150 million. "It was unfortunate, but I believe understandable, that it wasn't going to fly," says Upton.

The Raspberry Pi was an extraordinary hit, reaching five million sales in February 2015. But its impact in education has been more limited – mostly because of a lack of budget in schools and limited coding knowledge among parents and teachers.

The wider issue in education has refused to go away. In January 2012, the Royal Society released a report called *Shut Down Or Restart? The way forward for computing in schools*, which suggested scrapping the IT curriculum in favour of programming and computer science. A January 2011 report from Nesta into video-game development and the visual-effects industry found that poor IT education was adversely affecting digital creative industries. Then in May 2012, Nesta and the Science Museum jointly released *The Legacy Of The BBC Micro*, a report that called for a new Computer Literacy Project like that of the 80s.

'WE'D LOOKED BACK AT THE BBC MICRO AND KNEW YOU CAN'T REPEAT THAT PROCESS. THE KIDS, TECHNOLOGY, THE WHOLE SYSTEM, ARE DIFFERENT'



Michael Sparks, of the BBC's R&D team, Sinéad Rocks, head of BBC Learning and Education, and Howard Baker, editor, Innovations at BBC Learning

At around the same time, Howard Baker began thinking again about a successor to the Micro. Baker, an affable 59-year-old with the shoulder-length hair of an ageing rock star, is editor, Innovations at BBC Learning, which works out how to incorporate emerging technology into the BBC's education programming. "When those two big reports came out about the lack of skills in the UK, it was like a huge bell ringing. So we started thinking about what the BBC could do," says Baker, sitting in a conference room in Dock House, part of the BBC's expansive Media City campus in Salford Quays.

"When the people from Raspberry Pi came to see us, I remember thinking, 'I'd die to be able to do this'," he says. When he started to focus on the problem of how to get children re-engaged in coding. "I was cycling home and I thought: what's the cheapest thing we could put in their hands that they'd actually use? We were doing lots of work with *Blue Peter*, and they said any make on *Blue Peter* has to be under £2. So I thought, 'What can we give kids for £2?'

"We'd looked back at the BBC Micro and knew you can't repeat that process. Kids are different, technology is different, the whole system is different. So we thought, 'OK, so what's the next revolution?' Wearables, the internet of things, ubiquitous computing."

Baker and his team envisioned a small microprocessor board that children could program and so learn the fundamentals of coding. "We started to build up this picture. There'd be a little LED screen they could program, some buttons on it, maybe some input/output." Working with computer scientists at Manchester University, Baker's team built a prototype of something they called the Code Bug: a green, insect-shaped board with a USB connection and a 5 x 5 grid of LEDs which could be programmed to display simple messages. They tested it at some CBBC events around the UK. "The kids had huge smiles on their faces. We thought: actually, this looks like it could really work."

"Putting something physical in their hands was immediately very powerful," says Sinéad Rocks, head of BBC Learning and Education. "It gave a real learning experience. We had kids queuing up to have a go." The plan was to build a a few thousand Code Bugs to use at CBBC events around the country.

Then, in April 2013, Tony Hall took over as BBC director general. As part of a wide-ranging programme of changes, he announced plans to "bring coding into every home, business and school in the UK" by 2015. An accompanying video for the Make It Digital campaign harked back to the legacy of the BBC Micro, and included guest appearances by talent such as Brian Cox.

Baker and the Learning and Education team decided to show off the Code Bug to colleagues. "I remember being at this meeting, and they said, 'Well, what do you want to do with this?' I said, 'We're thinking we want it at events, maybe make 10,000,'" says Baker. "They said: 'What if we did a million?'"

"I think the first conversation was: let's give it to every child in the UK," Rocks says. "We often start from a massive ambition that would make your head spin, then we roll it back to something more practical. We started talking about who would this have the most impact with."

Putting out a million devices wouldn't be easy. In the 80s, critics – most memorably Clive Sinclair – complained about the BBC getting into bed with Acorn, a commercial company. Not to mention the political risk of the BBC spending millions in licence fees on hardware. "We knew this couldn't be delivered by the BBC alone. We needed partners on board – and, to put it bluntly, the partners would be paying for it," Baker says.

In December 2014, the BBC sent out an open call for companies to partner in manufacturing, financing and distributing a BBC-branded device. A meeting was arranged at Broadcasting House in London, bringing together representatives from leading tech companies and education startups. "It was one of those classic *W1A* meetings: a tiny stuffy room, people basically sitting on each other's laps. But it was completely surreal, because there was so much creativity in the room. Everyone was there," says Clare Riley, group manager at Microsoft's Education Relations team, who was present. Remarkably, 25 companies signed up. ARM provides the processor. Microsoft has built the online coding platform. Samsung has designed an app. And 16 education partners, including Code Club and the Open University, are distributing and providing materials for the device. The September launch will be supported by a range of BBC output.

Not everyone's happy with the scale of the project: the University of Manchester team, who'd been instrumental early in the project, is no longer involved. In April, three of them funded a device – the CodeBug – on Kickstarter. Backers noted similarities with micro:bit. "It's complicated, and the BBC has a big legal department," says CodeBug co-founder Andrew Robinson. "Ultimately I want to be sympathetic, because we want the same thing."

Meanwhile, Baker's team rushed to build enough micro:bits for a pilot project in 13 selected schools that would take place during January 2015. The prototype, built by Michael Sparks of the BBC's R&D team, was an unpolished blue single-board computer with an LED display, USB connector, two simple face buttons and an array of inputs and outputs for peripherals. His team also developed a browser-based environment to let kids code in Blockly and Python, and then test the results using an on-screen simulator.

"We had a week to send out 500 devices," Baker says. "We took over the kitchen in BBC Learning. We sent an email: 'Please, anyone who can, come and help.'" Sparks remembers: "There was this delightful moment when a colleague sent an email saying: 'We've shipped to the schools. I said, 'You do realise that this is the first microcomputer the BBC's shipped in 20 years?'"

On March 12, 2015, Tony Hall officially announced the micro:bit at the Make It Digital launch in London. But this left only six months until the start of the school year to test, manufacture and ship a million devices, to train teachers to use them and distribute them to every secondary school in the UK.

The device also had to be completely redesigned, with a new ARM Cortex M0 processor and new features such as an accelerometer, magnetometer and Bluetooth low-energy connectivity. "There was a huge feature explosion. Every partner wanted their feature to be advertised on the front of the board," says Mike Vanis, lead kit designer at Technology Will Save Us. The design startup, which makes popular coding kits for children, has designed the final version of the micro:bit that will be delivered to schools. It's June when WIRED visits, and the company's Shoreditch

Winterton Community Academy pupils Simone Sullivan, Alex Houghton Birkett and Eleanor Lonsdale headquarters in London is littered with design iterations and notes.

The blue prototype board suffered the same problem as the Raspberry Pi: it would appeal to a small number of knowledgable, skilled children, but might intimidate the majority.

"When you look at the Raspberry Pi, it's just hardware," says Bethany Koby, co-founder of Technology Will Save Us. "We wanted to design something that was fun, cool and interesting, so when they open it the kid goes: 'Wow! what's that?' And immediately they want to interact with it and make it theirs."

The computer-education market is crowded with hardware – the Pi, Arduino, kits such as Kano – but Koby believes the micro:bit is unique. "At the moment, there's nothing designed for this age group," Koby says. "The Raspberry Pi is not for them. Arduino is definitely not for them. That's why this is such an interesting platform."

The micro:bit has an attractive, rectangular design: the front shows the LED matrix, two buttons and a combined croc-clip/edge connector, which can connect to a wide range of other devices, including Raspberry Pi and Arduinos. On the back is a micro USB port, the ARM processor and a reset button. "The front is your project place. On the back you've got all the tech stuff: you've got an explanation of where everything is, you've got the chip and the capacitors," Vanis says.

'MY VISION IS SEEING MY SUCCESSOR IN 30 YEARS' TIME, POINTING TO PEOPLE WHO HAVE CAREERS IN DIGITAL CREATIVITY AS A RESULT OF WHAT WE'RE DOING'

Children can program the micro:bit using Blockly, TouchDevelop or Python before loading their own projects over USB or using a smartphone app. The display can be used to show messages or animations or play simple games. Using the accelerometer and magnetometer, they might build a simple pedometer or fitness tracker. It can also be used while tethered to a computer to control desktop programs; Sparks demonstrates a version of *Flappy Bird* using the micro:bit as a controller.

"It's not like the Pi. The Pi is a full computing platform," says Gary Atkinson, director of emerging technologies at ARM. "The micro:bit is an edge device. It's a sensor. It can't run Linux, it can't run Windows. You program it to do a handful of quite fancy things. The children might stitch it to their clothes and make a wearable, they might 3D print a housing for it."

"There's a lot of expansion capabilities," says Tom Ball, a Microsoft researcher who helped to develop the micro:bit's coding platform. "I think we'll see kids starting with simple programs, then they could do some experiments, collect data and hook it up to other devices."

* * *

The micro:bit's development has not been without its problems. Because of the extensive design changes, the team missed its target of mid-June to unveil the finalised design to the press and schools. Such delays are typical of hardware launches, but the postponement does call into question the decision to announce the project only six months in advance.

There are also lingering questions about whether the micro:bit will be given time to prove itself: the BBC is currently committed to only one year of the project. (As WIRED went to press, the corporation and its commercial partners announced plans to launch a non-profit company to oversee the micro:bit legacy and to make the hardware open-source, allowing other companies to manufacture and distribute devices.)

Then there are the corporation's many political enemies, who may see the micro:bit as a conveniently timed goodwill exercise with the licence fee up for review in 2016. On this, the director general is bullish. "The time to make an impact and inspire people is now," Tony Hall tells WIRED. "It feels like we're at a tipping point, and the BBC can help put the spotlight on digital creativity like never before.

"I believe that only the BBC is able to bring together the wide range of organisations capable of doing this. If anyone had any doubts about our ability to do a project on this scale, they shouldn't have them now."

The micro:bit is, at the very least, late to the party: in September 2014, following the recommendations of the *Shut Down Or Restart?* report, the Department for Education instituted a computing curriculum that requires children to learn coding from primary-school age.

But, according to the teachers WIRED spoke to, the intervention is still sorely needed. "The BBC is in a very special position, in that it reaches such a huge percentage of the population through all its channels," says Clare Sutcliffe, co-founder and CEO of Code Club, who will be creating after-school activities centred around the micro:bit. "They're in the position to make it part of the natural conversation of the country, so that it becomes as normal to talk about computer science as talking about catching the bus. So for them to do this, well, it's really quite amazing."

"What the BBC can do is it can reach into people's living rooms," says Peyton Jones. "What the BBC Micro did was to get personal computing off the hobbyist's workbench and on to the kitchen table. That's something only the BBC could do."

Whether or not the micro:bit is successful won't be measurable for a while; that's the trouble with trying to inspire a generation. "We can measure the data of people using it," says Jessica Cecil, controller of the Make It Digital project. "My vision is someone sitting as my successor in 30 years' time, pointing to people who have careers in digital creativity as a result of what we're doing now, just as happened with the BBC Micro."

"It would be great if it became a playground craze," says Baker. "But, yeah, what I want is when you talk to a CEO of a big company in 20 years and they go: 'It started when my micro:bit was given to me in year seven.'

"So," he smiles. "I've got a long time to wait." ▥

Oliver Franklin-Wallis is assistant editor at WIRED. *He interviewed Simon Pegg in 08.15*

PHOTOGRAPHY: JASON MADARA

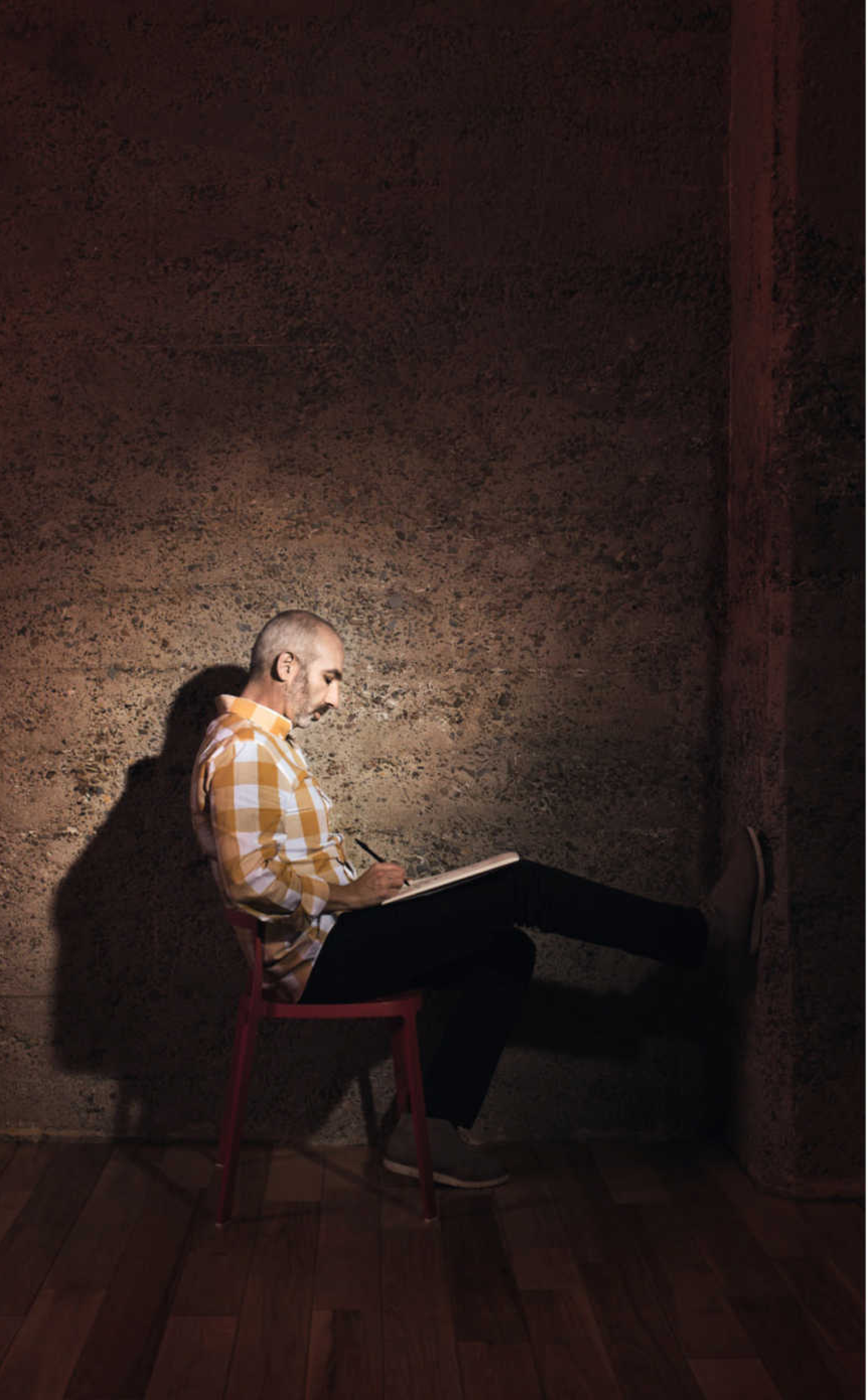
UNDER THE SKIN

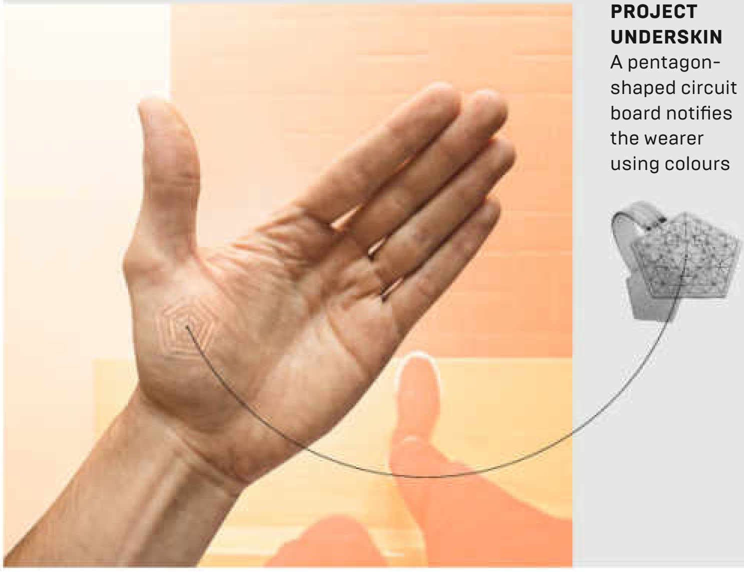
BY JOÃO MEDEIROS

GADI AMIT DESIGNED THE FITBIT, THE LYTRO CAMERA AND GOOGLE'S MODULAR PHONE. NOW HE WANTS TO REDESIGN YOUR BODY

In 2013, two San Francisco-based entrepreneurs, Chris Bruce and Mathew Spolin, contacted a local product designer called Gadi Amit with the idea of making a wearable device. "They had some core sensors and a general idea for the branding," Amit says. "But, as is usually the case with wearables, most of the sensors brought to us were raw inventions from a medical lab. The end users are not medical professionals." In fact, in the case of Bruce's and Spolin's device, the Sproutling, the end users were babies.

When Amit (*pictured*) starts working on a new project, he first makes a series of prototypes using clay, foam and wood, and starts playing around with various shapes and forms. His team works with pen and paper before anything is rendered on a computer screen. It's a process that differs from the approaches of other designers, who often take a more analytical, quantifiable approach. What's important to Amit is the serendipity that comes with the process of discovery. "I'm an outsider in the tech world," he says. "I work with some of the most cutting-edge technologists on the planet, and most of them aren't used to working with designers.





PROJECT UNDERSKIN
A pentagon-shaped circuit board notifies the wearer using colours

Some have a sort of superiority complex towards us, something along the lines of, 'We went to engineering school, we're used to telling a designer exactly what to do.' This sense of rational dominance, as if tech is developed better by setting priorities through analytics or tech constraints, is more important than the cultural human aspect of the design. I'm more humanistic, serendipitous, emotional."

When it came to the Sproutling, Amit took a series of plaster baby legs and calves, and developed prototypes made of foam, cardboard and, later, 3D-printed objects with Velcro. He then tested them with real babies, having them wear the devices for hours on end. "We ended up placing the sensor not on the wrist, but on the calf, with an adjustable, replaceable, elastic strap," he says. "Why? Because babies triple in size in their first year."

Amit is behind some of the most celebrated design products of the past decade: the Fitbit; the Lytro Light Field Camera, a pocket-sized camera that can focus images after they are captured; and Google's Project Ara, a modular smartphone which can be configured by swapping in different CPUs, screens and cameras. These products are characterised by their rounded edges, soft plastics, bright colours and sturdy materials. It's an aesthetic that, in a sense, is the antithesis to the masculine lines and cold metal that dominates Apple's hardware design.

"My process is more akin to sculpture than it is to engineering, analytical thinking or machining metals. It's artistic, chaotic and very hands-on," Amit says. "I found out that it's a process that's exceptionally effective, not only on exterior forms and devices, but also for the interior architecture of electronics. The ability to create an internal layout of electronics is a sort of secret ingredient, and it's behind a lot of project success stories we created such as Lytro, Fitbit or the Ara."

Sproutling's wearable band has a heart-like form that wraps around a baby's ankle. It tracks and predicts sleep patterns and optimal sleep conditions by measuring their body temperature and movement. Room temperature and noise levels are also monitored. Data is visualised using a colour-coded system that is transmitted to the parent's smartphone and a base station, which can also wirelessly charge the device. "I call it a glanceable user interface," Amit says. "It's important that it doesn't require an alphanumeric data flow at a glance. When the base station flashes a red light it effectively means, 'Go and check the baby'. It's allowing the parents to be connected to the state of health of the baby. It allows them to live more predictable lives. When parents become more familiar with natural patterns, it reassures them that everything will be OK."

Sproutling took nine months to design. Bruce and Spolin then took the prototypes and usability studies they had developed with Amit and presented them to investors. On January 29, 2015, they raised a $6.6 million (£4.2m) round of funding.

GADI AMIT'S TOP DESIGN PRODUCTS

1. FITBIT
Since launch, the wellness tracker has sold 20.8m units

2. LYTRO
A camera that allow photos to be refocused after exposure

3. SPROUTLING
A leg-band baby monitor – the first batch has already sold out

The son of architects, Amit was born in Tel Aviv, Israel, in 1962. After completing military service, he enrolled to study industrial design at the Bezalel Academy of Arts and Design in Jerusalem and graduated in 1989. He moved to San Francisco four years later to work at design firm Frog, later becoming vice president.

In 2000, Amit left to co-found his own business, NewDealDesign. He wanted to create a smaller, interdisciplinary company that followed his personal design philosophy, which he calls "the wisdom of the hand". Its early portfolio was eclectic: a rehabilitation device for athletes called Game Ready; MicroVision Nomad, a wearable similar to Google Glass; and the AVC Soul portable CD player. Its first big successes were the Palm Zire, which came out in 2002 and sold more than a million units, and the NetGear Platinum II modem.

In 2007, Amit was approached by Fitbit. The startup's founders, James Park and Eric Friedman, had, says Amit, "a circuit board and a vision". At the time, wearables were clunky pedometers with poor user interfaces. Fitbit wanted a focus on wellness, not fitness.

"Some of the early wearables were a way to flaunt the ego," Amit says. "One of the biggest discoveries we made when we researched the market was that many users, specifically female ones, don't want to show their stats. They didn't want to be seen as douchebags who flaunt the fact that they walk a lot. That insight really helped the Fitbit in the early days."

The first Fitbit, the Wellness Tracker, clipped on to its owner's clothes. It measured steps, calories burned, distance and floors climbed. It was faithful to Amit's design philosophy: a device that was present but didn't need to announce itself every five minutes. You could put one on and forget about it.

Gadi Amit thinks that in a few years we could be wearing up to ten devices on our bodies and clothes to monitor and organise our lifestyles. "How will we interact with this stuff?" Amit asks. "And the thinking in my team was that we need to establish some kind of cross-platform user interface where we co-ordinate data from all the devices."

A year ago, Gadi and his team started tackling this problem. They came up with a conceptual device with a glanceable interface that would connect all such data trackers. They called it Project Underskin.

At first, Amit wanted to create a new wrist device. "I quickly changed my mind when I realised everybody else was also doing a new wrist wearable," Amit says. His solution? A chip that would be embedded under the skin. "It was something that would be concealed but would also be on us at all times and everywhere we went," Amit says. "It was a controversial decision. Embedding electronics under the skin was considered too invasive. One of the designers said he felt queasy about it. He had just tattooed his arm from shoulder to cuff-line. I just asked him, 'How can you be sensitive to *that*?'"

Amit and his team researched body augmentation. "We found out how common it was throughout history," he says. "Five hundred years ago, it was natural to insert jewels into one's body. As we move into the digital era, it will feel natural to have a chip under your skin. There are already a lot of implanted devices – heart defibrillators, insulin implants, identity chips..."

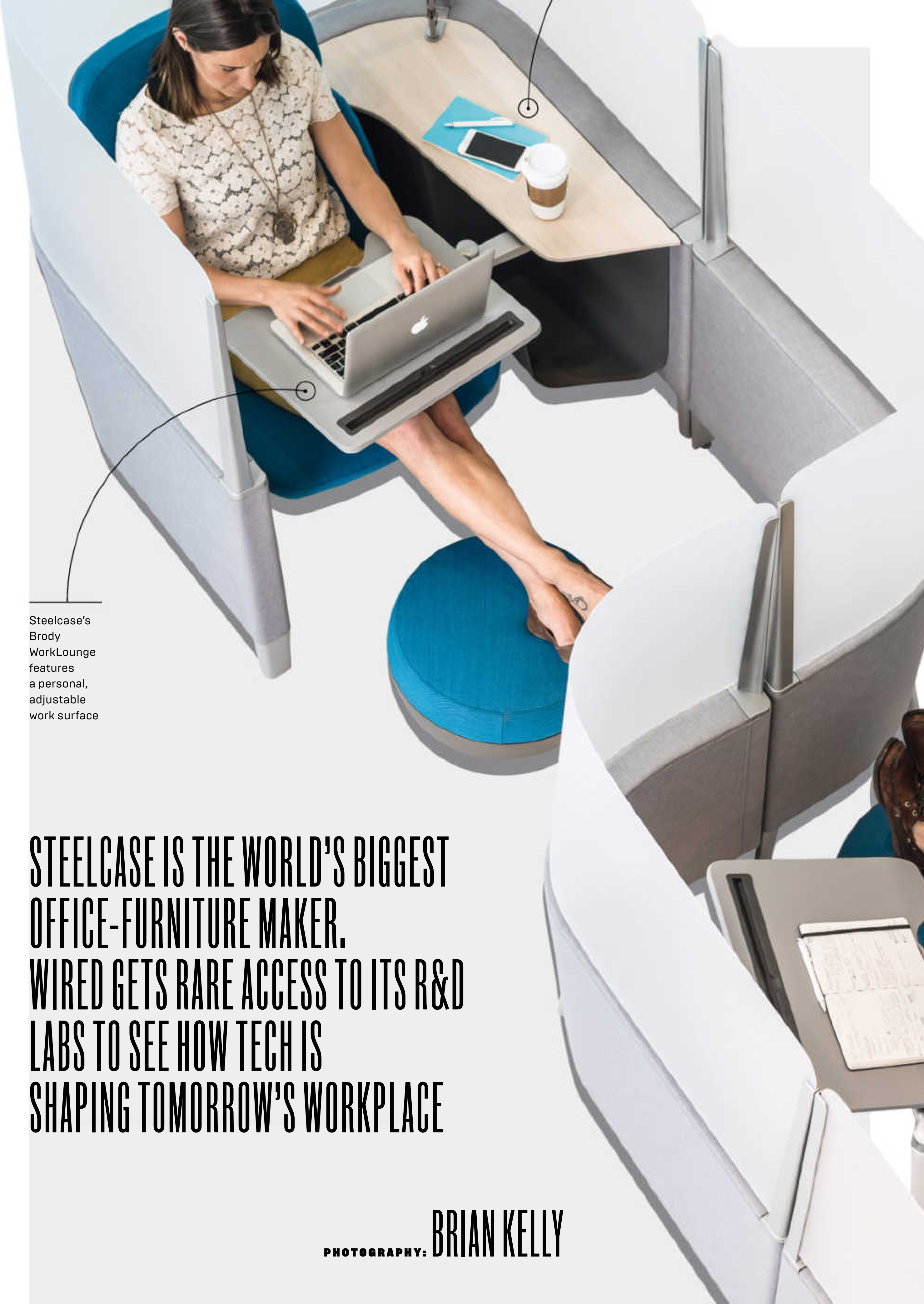
Project Underskin is based on a digital tattoo implanted in the user's hand. Amit's team came up with a two-node pentagon-shaped circuit board: one on the palm; the another on the upper side of the hand. "We found it was stable in terms of readability," Amit says. "It doesn't change much whether you close or open your hand."

The tattoo can send near-field communication signals to unlock doors and authenticate credit-card users. It can track location and movement and display information such as blood sugar levels or heart rate. It won't convey alphanumeric information, but rather codify it geometrically. The user gets to decide what is displayed and how it is transmitted. Amit calls it an introvert user interface. "It's completely personal," he says. "No one knows what it means, because the context is made in your mind. That's the beauty of it."

Project Underskin started as a provocation but, after its announcement, Amit claims he has received interest from various companies and individuals. "It probably won't come to fruition for a while, but it will be imperative to build something like this," he says. "The proliferation of digitally enhanced devices is just going to be there and it will be impossible to control them. We can't just carry our phone everywhere we go."

João Medeiros is science editor at WIRED. *He wrote about memory experts in 09.15*

> 'One of my designers said he felt queasy about embedding electronics under the skin. He had just tattooed his arm from shoulder to cuff. I asked him, "How can you be sensitive to that?"'



Steelcase's Brody WorkLounge features a personal, adjustable work surface

STEELCASE IS THE WORLD'S BIGGEST OFFICE-FURNITURE MAKER. WIRED GETS RARE ACCESS TO ITS R&D LABS TO SEE HOW TECH IS SHAPING TOMORROW'S WORKPLACE

PHOTOGRAPHY: BRIAN KELLY

WORK. LIFE. BALANCE.

BY NICK COMPTON

The side table conceals power points and storage for luggage

Opaque screens help foster a sense of psychological security

Grand Rapids, Michigan, a couple of hours' drive west of Detroit, is known as Furniture City. Establishing itself as the centre of the United States' furniture manufacturing industry at the end of the 19th century, the Great Lake State's second biggest city is still prolific in the field. However, as time passed, local producers began to specialise. Today, office furniture is Grand Rapids' specialty.

The biggest and best-known company in the region is Steelcase, which has become the *de facto* provider of the world's office furniture. With revenues of just over $3 billion (£1.9bn) in 2014 and a net income of $87.7 million (£56.5m), it is the largest office-furniture manufacturer in the world. Those numbers represent a sharp turnaround for a business that was significantly damaged by the global financial meltdown of 2008. Steelcase credits its current buoyancy to the fact that its clients are not merely ordering desks, chairs and shelving, but completely reconfiguring their workspaces – ensuring, as the company literature says, they "fully respond to new ways of working".

This is borne out at Steelcase's new Innovation Center, a hub of constant improvisation and experimentation. Here, you find treadmills in front of stand-up desks in soundproof "enclaves", drop-in-drop-out video conferencing suites and strangely shaped lounge chairs. The place appears to be in a state of flux, ready to be ripped out and rethought at any moment. Steelcase has first-hand experience of re-imagining workspaces and creating new ways of working: until recently, the company's research and development operation had been housed in an enormous glass pyramid which was completed in 1989 at a cost of $111 million. In 2009, though, after a 99 per cent drop in profits, Steelcase decided to shift most of its production out of Michigan and rationalise its real-estate holdings. The Pyramid was vacated and Steelcase's designers, researchers and model makers were installed in a smaller (though now handsomely remodelled) former manufacturing plant just across from corporate headquarters.

The Pyramid had symbolised a commitment to R&D that went far beyond ergonomics, physiology and lumber support. In 2009, Steelcase knew that if the accommodation for its research team was more modest, its ambitions could not be. It would develop the smartest, most informed take on trends in the contemporary workspace and build product around those insights. It also used the relocation and downsizing of its research facility to test new ideas, to remake its own corporate culture and to work out how one leads the other.

"If you want to change your culture, getting the physical space to match the body language is critical," says Steelcase CEO Jim Keane, a lean, 55-year-old Chicagoan, who has been in the post for 18 months. "And if you change the culture but don't change the space, the space will anchor behaviours in the past."

CEO Jim Keane joined Steelcase in March 2006 as president. Behind him is a custom "library" wall design

Within the Innovation Center, Steelcase constantly reviews how its own space – and that of its clients – is used. It studies success stories at companies such as Apple and Nike, and projects run by design company IDEO and Stanford University's Institute of Design. It creates and re-creates office layouts and systems in order to discover how employees work within them. It records where people move, how long they stay in particular places and what they do there. Data is king: teams conduct interviews but also use sensors to

A semi-private breakout area at Steelcase's 30,000m^2 Innovation Center in Grand Rapids, Michigan

track employee movement, both in-chair squirming and general mobility. Crucially, designers model furniture prototypes on-site as part of these experiments.

The company has other design and research centres in the US, Europe and Asia, and has forged partnerships with institutions such as MIT and Stanford to keep track of the latest academic research on the effects of the physical environment on creative thinking and, ultimately, productivity. The company invested $36m in R&D last year, and it has always maintained this spend at somewhere between one and two per cent of revenues, which is generous for the sector.

"There are a lot of people working in environments designed for the person who had that job 20 years ago," says Keane. "I know we can make a difference to that." In its biggest break from the past, the company is designing around how people really behave, rather than some idealised goal. And today's workspaces are being squeezed. The British Council for Offices found that in 2013, the average office allowed 10.9 square metres per workstation, down from 11.8 square metres in 2009 and 16.6 square metres in 1997. The modern office is smaller and more densely populated than in the past. Part of what Steelcase is selling is strategies for squeezing personal space in smarter ways that will increase productivity. Its biggest long-term bet, though, is that work will still happen in offices.

According to Gallup's most recent "State of the American Workplace" report, published in January 2015, almost 40 per cent of full-time workers in the US work remotely, and of these, some 15 per cent are permanently out of the office. Many are working not at home, but in coffee shops and other "third places", to use the term coined by American sociologist Ray Oldenburg, author of *The Great Good Place*.

Steelcase, for obvious reasons, is focused on stalling and stunting the progression of the latte-and-laptop remote work trend. "If you are expecting people to commute every morning to get to a specific place, there has to be some pay-off," Keane says. "It has to be the best place they can work. However, if their dining room is better than the office you provide, then they should stay at home. And you should save even more money on real estate.

"But companies are finding that business is much more about innovation and collaboration, which is based on trust, which is based on face-to-face interaction. So you don't want your employees to be in Starbucks or some co-working place."

The answer, or at least the answer Steelcase is selling, is not about working-playgrounds: the ping-pong tables and beanbags of the tech giants. Although it has Silicon Valley companies among its clients, it also has a good portion of the *Fortune* 500, from Boeing to General Electric. As Nikil Saval, author of last year's *Cubed: A Secret History of the Workplace*, says: "Steelcase's market is standardised solutions."

However, this is no longer selling, so the challenge is to find what will. "All of us grew up working in standard spaces," says Keane. "There were three sizes of cubicles and there were three sizes of private office. Eventually, there was just one size fits all. Well, that model is broken."

An office in the Innovation Center. The pink unit is a media:scape Lounge for large-screen collaborations

The open-plan office – the cubicles of the American bullpen or the flat vistas of North European workspaces – has proved to be a poor way to engender employee happiness and productivity. Office workers are distracted once every three minutes, according to research from the University of California, and it takes 23 minutes to regain "flow", that happy condition of focused productivity. It's no wonder many workers are abandoning the office for Starbucks.

Steelcase's solution also began with the café. In 2009, it renovated its own HQ to create the WorkCafé, which integrated working spaces. It is now a sprawling area of tables, lounge chairs and even a library-like zone. There are power points everywhere.

A 2012 study by Gallup suggested that the most engaged workers spend up to 20 per cent of their time working remotely. A key part of Steelcase's renewal strategy has been to make the remote seem less, well, remote.

Using the WorkCafé as a laboratory, Steelcase observed how worker behaviour changed over time. Enclosed, individual spaces proved popular, so it added more. It also ensured that senior management used the café, legitimising it in the eyes of the other staff. "It takes a little time," says Keane. "In the first few days and weeks, it was all younger employees. But now you will find it's a cross section of ages and functions. There are early adopters and late adopters, but if you give it time, behaviours change. Give people a choice and they will make better decisions than we can make for them." This is Steelcase's big new idea.

Steelcase's WorkSpace Futures research unit is headed by Donna Flynn. Based in the Colorado mountains near Boulder, Flynn tele-commutes, only occasionally visiting Grand Rapids. Flynn trained as an anthropologist at Northwestern University in Chicago. She studied human trafficking, worked at a public policy think-tank and was all set to take the quiet road to academic tenure, before opting for corporate cut and thrust. She joined Steelcase four years ago and now has a 19-strong research team in the US, Paris and Hong Kong.

The team's key insight is that we need different kinds of space, at different times. Flynn talks about the civilised and productive office providing an "eco-system of spaces" to suit the task, or provide for post-task rest and renewal. She talks about an office that "humanises, empowers and connects" people, one that mobilises a kind of "collective genius". Steelcase has adopted the term "palette of place" to describe this. It also talks about a "palette of posture" – a system that encourages people to stand up, move around and sit down; and a "palette of presence": a range of places where people can meet, collaborate and connect with colleagues, real and virtual.

Activity-based working is the aim, and it requires spaces (and management) that allow for it. Emailing could be done at a conventional desk, or a standing desk, or not your own desk. Creating a new office ecosystem could mean sacrificing a desk for a locker and a variety of work stations: sealed-off, soundproof enclaves for periods of intense flow; small spaces for quick catch-ups; video-conferencing kiosks for *têtes-à-têtes*; and video-conferencing suites for virtual group meetings. Other spaces include project rooms, shielded conversation lounges and, crucially, personal retreats and quiet privacy zones.

The effects of being sat at a desk all day – internal organs compacted, blood pooling in our ankles – are well known. But it's the brain that Steelcase is interested in. The WorkSpace Futures team is working with neuroscientists to try to understand our capacity for distraction; why attention is a finite resource. Our brains can only manage four or five hours of sustained and concentrated mental effort before exhaustion. The point of the "ecosystem of place" is to provide spaces where that mental energy is not burned out by useless distraction.

Yet neuroscience also suggests that our limbic systems and prefrontal cortices – where all our knowledge work takes place – are hard-wired for distraction. The new and the different reward us with a dopamine rush. And once we are distracted we get ever more distracted.

Steelcase's most profound insights come when neuroscience and anthropology connect. Back when we were hunter-gatherers, the most distractable survived. Those whose peripheral vision picked up the prowling sabre-toothed tiger were the most likely to survive. This inheritance has left us susceptible to visual distraction – which is why it's almost impossible for you to resist that bouncing email icon at the bottom of your screen. Another challenge of the open-plan office is lack of privacy. For Steelcase, privacy is made up of acoustic, visual, territorial and informational components that are constantly shifting. But it insists that even in highly collaborative companies, people need private space and time to think, digest and process: counter-intuitively, effective collaboration requires private time. As Susan Cain, author of *Quiet: The Power of Introverts in a World That Can't Stop Talking* and a Steelcase collaborator, says: "There is a complete misunderstanding of what collaboration is. There are lots of people who need to go away, to be on their own to think, and then come back and share."

Donna Flynn, VP of Steelcase WorkSpace Futures. She has previously been an anthropologist and a Microsoft UX manager

The Brody WorkLounge system, launched in April 2015, is the design that most clearly embodies Steelcase's mission to allow for professional private moments. Eight years ago, the company decided to move into furniture for school and universities. As product manager Mark Walters explains, the design that would later become Brody was initially imagined for college libraries.

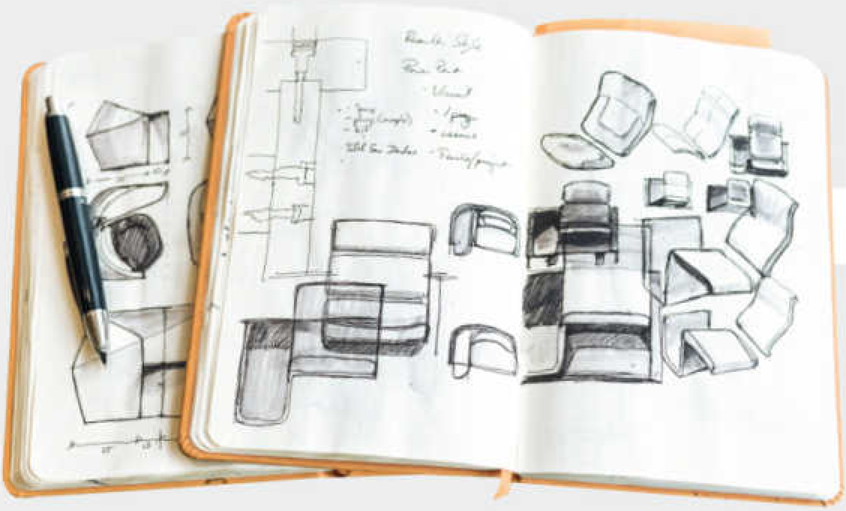
The company examined how students spend time in libraries. It noticed that they gravitated towards lounge chairs when they wanted to generate some serious intellectual flow, often dragging the chairs to isolated spots and scattering books, bags and paraphernalia around them. They would then spend hours in the chairs, adopting all manner of curious poses: legs crumpled and twisted, shoulders hunched, spinal column out of whack. Steelcase determined on creating the ultimate work-friendly (and spine-friendly) library lounge-chair. And then realised that the chair could work in the office.

The Brody looks like a business-class seat in a new Airbus – an ergonomic cocoon designed, Walters says, to "protect you from yourself". The body is positioned in what Steelcase calls an "alert recline" with both upper and lower back supported. An angled work-surface holds technology at eye level while an arm support relieves pressure on shoulders. The new worker is nomadic, often hauling around a bulging rucksack, so it includes a built-in bag space. This allows the user to easily dip in and out of their bag in search of notebooks and snacks, without interrupting "flow". Finally, an opaque screen blocks out distractions without sinking the user into gloom. The Brody is, Walters says, "a psychological safe spot".

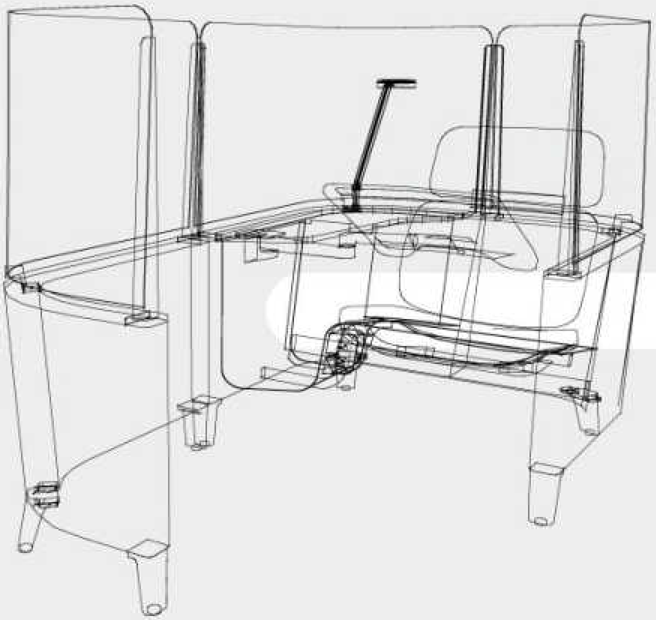
Every new Steelcase design begins with the behavioural research coming out of Flynn's WorkSpace Futures unit, along with observations in the field. Then the company designs, proto-

FROM SKETCH TO PRODUCT: THE STEELCASE BRODY CHAIR

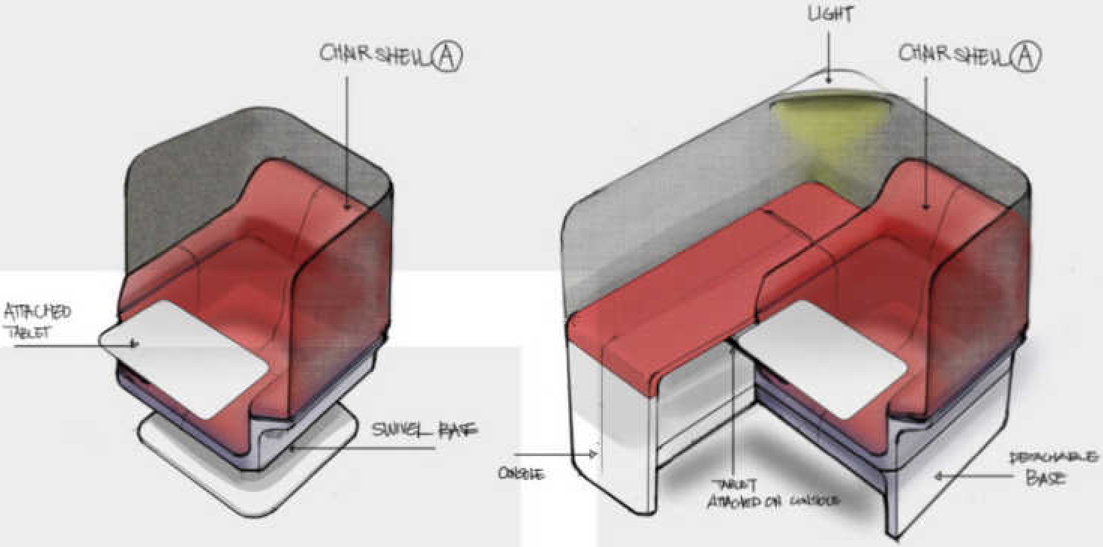
The Brody WorkLounge – launched in 2015 – is Steelcase's attempt to combine a psychological sense of privacy with ergonomics and practicality. Here's how its design evolved.



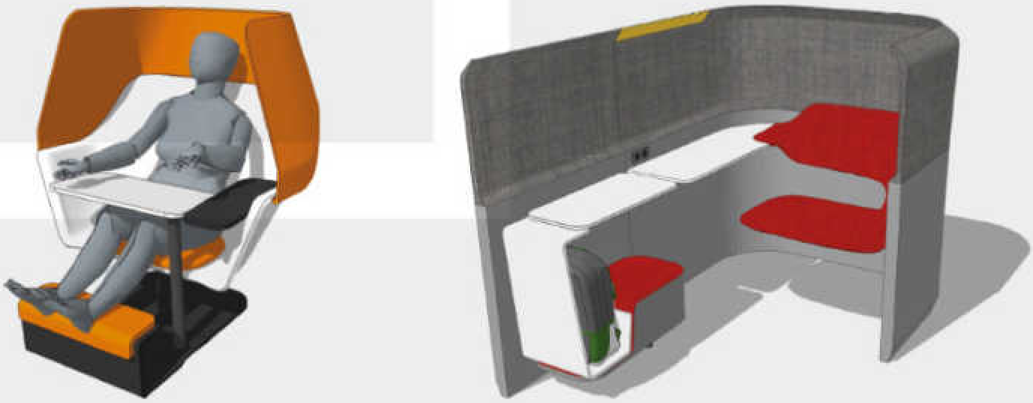
1. INITIAL SKETCHES
Based on researching the study habits of students, designers sketched out their first ideas.



4. PRODUCTION WIREFRAME
This detailed 3D model shows the final Brody design, down to the re-arrangeable components.



2. ADVANCED SKETCHES
Once designers had decided on an "enclosed" idea for the chair, they explored useful features, such as a swivel base.



3. REFINED RENDERINGS
CAD software let designers create detailed renderings, with elements such as textures and the Brody's modular form.

types and builds. Before it launched its top-of-the-range desk chair, Gesture, in 2013, Steelcase spent time observing 2,000 people in 11 countries. It noticed that new technologies were encouraging us to sit in new ways – twisting and squirming in our seats as we went.

Steelcase announced that it had discovered nine new postures – The Draw, The Multi-Device, The Text, The Cocoon, The Swipe, The Smart Lean, The Trance, The Take-It-In and The Strunch – around which it designed the Gesture chair. It encouraged movement and offered dynamic support. And, unlike Herman Miller's iconic Aeron, it was easy to adjust.

Steelcase's healthcare wing, Nurture, conducted 18 studies and 15,000 hours of observation before designing a new model examination room and developing Empath, a heavy-duty adjustable lounge chair to replace the traditional table. SES, Steelcase's education arm, studied 35 classrooms in 12 schools and colleges before developing Node, a laptop-friendly classroom chair on wheels, with built-in backpack storage.

"What they are doing is a real step forward, to make the workplace more comfortable for everyone," says Susan Cain. "Being able to switch between private and social is good for all."

Cain got involved with Steelcase when its former CEO Jim Hackett saw her 2012 TED talk. "He told me he was an introvert and that he was increasingly concerned with the lack of privacy and space in offices," she says.

Cain claims one in three of us are introverts, distracted by the clamour of the open-plan office to the point of functional shut down. "I had spent six years working on the book," she says. "There is a lot of research out there, it just seemed no one had picked up on it."

Cain and Steelcase are working on introvert-friendly working retreats – largely soundproof, frosted-glass boxes called Susan Cain Quiet Spaces. "I just hit them with 15 principles," Cain says. "Things like the need for visual privacy, acoustic privacy, the use of natural materials."

Flow, Cain's favourite, is a small office with a built-in desk and wallpaper that suggests rows of books. There's a brainstorming room called Mind Share; decompression chambers, Be Me and Studio, where the less gregarious can escape; and the Green Room, an intimate hang-out space designed for two or three people to huddle on an L-shaped sofa.

Cain's Quiet Spaces are not unlike the glass boxes offered to management and senior staff in many offices, though with more sophisticated environmental controls – and, of course, yoga mats as standard. "I was a corporate lawyer for seven years and I had my own office," Cain says. "But I was doing 16-hour days of pretty intense, complicated work. I needed that office. I've talked to designers who are re-imagining the office and to them, the private office is only about status. I think that's a real misunderstanding. People need them. The problem is the access and the expense."

Keane, a self-declared non-introvert, works from a number of Susan Cain Quiet Spaces, mostly an ever-so-slightly expanded version of Flow, which is still small in CEO terms. He also has a Green Room, which he imagined he would only employ for entertaining visitors, but now uses all the time.

He can control the colour, temperature and intensity of the light in these rooms and pick from a range of relaxing white noise. The key, insists Keane, is the control. "The point is that you are choosing. I'm not sure that these are the perfect settings, but they are my settings – not something decided by central facilities."

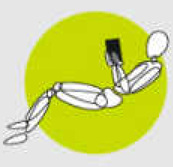
Crucially, adopting Steelcase's equipment and approach requires managers who will allow their workers to make those choices. And this, admits Keane, is the toughest part of the pitch. Beyond the spatial economics, the great advantage of open-plan offices is the ease with which workers are watched and surveyed. In most cases, Steelcase will spend time with a company before any orders are taken. It will observe, analyse and interview and then make recommendations. And what it really recommends is systemic change.

"People do realise that the model is broken; they get that. But then they ask, 'What is the new one thing that replaces the old one thing?' And we explain that there is no new one thing. You have to embrace the idea that you need a range of settings; that there are wild differences between people," Keane says. "By the time you get to lunch, they get that. They are fired up and energised. But then the natural forces of standardisation kick in again and they say, 'Oh, we could really only have one or two of the new things.' And, 'Well, perhaps some people can work the way they want to work but not my people.' The hardest part is asking organisations to lead in new ways. But eventually they get that as well.

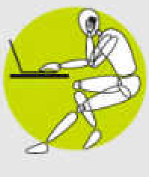
"And the thing is," Keane continues, "imagine if it were the other way around. What if we said we are going to make all offices the same? That

NINE NEW POSITIONS: A GUIDE TO SITTING IN THE 21ST CENTURY

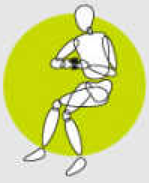
Steelcase found that workers rarely sit upright in their chairs. Here are nine positions it says tech has enabled. GV



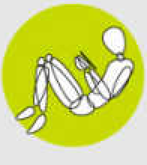
1. THE DRAW
Leaning back while reading on a tablet



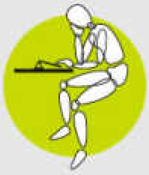
2. THE MULTI-DEVICE
Arm-rests aid the multitasker



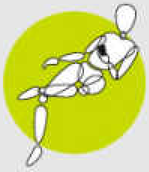
3. THE TEXT
Smartphone-oriented, with optional support



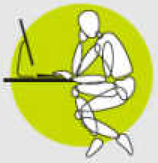
4. THE COCOON
Popular among millennials – but keep it brief



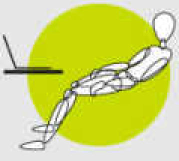
5. THE SWIPE
Shoulder and back support for tablet sessions



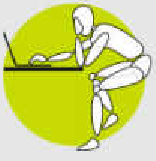
6. THE SMART LEAN
Mixes privacy and collaboration



7. THE TRANCE
For long, intense bouts of focus on a large screen



8. THE TAKE-IT-IN
Relaxed for laptop reading



9. THE STRUNCH
A stretched-out, tired hunching

The Brody WorkLounge, with extras including a dash task light, full Privacy Lounge extension and a footstool

would be a much tougher sell. It seems pretty obvious that to give people the choice to find their best way of working is better than making them work in an automaton way."

Steelcase's next big push, and an area that is energising Keane and Steelcase's vice president of global design, James Ludwig, is taking this smart office and connecting it to the internet of things.

"For a long time we have predicted that technology would no longer simply be something we would carry around with us or would have on our desks; it would be in the environment," Keane explains. "It's happened in the car, and it's happening at home, so it's surprising how little it has happened in the workplace. And we can't think of any good reason for that, apart from the fact that the workplace has been stuck in the old model for so long."

Steelcase has been developing embedded sensor technology that will build a picture of personal preferences and choices so that, eventually, your environment will mould around you as you navigate the new ecosystem of spaces. The chair you sit on remembers the settings of the last chair you sat on, and adjusts itself around you.

At the NeoCon office equipment fair in Chicago in June 2015, Steelcase made its first moves in that direction. It introduced a version of Brody with a heated chair, speakers in the headrest and a red light activated by a sensor, signalling that the seat was occupied. It also launched a version of Gesture that monitors posture, sitting position, heart rate and stress levels. It showcased Media:scape Team Studio with VIA (Vertical Intelligent Architecture), a video-conferencing technology with a kind of shared virtual whiteboard, closing what it calls "the presence disparity gap".

Keane and Ludwig acknowledge that some might see all this tracking as an invasion of privacy. But, Keane says, that has often been that way with new technology. "Initially, new software might feel a little creepy, but with more use it seems perfectly normal. There are other technology/privacy issues that are just plain creepy." He suggests Steelcase's innovations are in the creepy-becomes-the-norm camp.

This kind of technology could become an everyman's automatic professional/personal/well-being PA. And for Keane it is all about reducing what he calls "cognitive overheads" – the bothers, annoyances and diversions that suck your creative energies.

Of course, you can argue that the crisis of the modern office goes way beyond rearranging the furniture. Saval has also spent time in Grand Rapids and credits Steelcase with making an "honest attempt" at increasing the greater good. But ultimately, he says: "How much you want to keep people in the office is a matter of how unhappy you want to make them."

Steelcase would insist that it is not encouraging a culture of free-snacks-and-foosball presenteeism. Quite the opposite: it is about your making the most of your strictly limited reserve of quality attention time while you are at work.

More fundamentally, though, Keane does believe that better space can make you happier, fitter and more productive. "Physical space can make you feel like you had a good day," he says, "that you made real progress." ▥

Nick Compton wrote about Ron Arad's rules for innovation and creativity in 10.14

OVERHEARD AT WIRED THIS MONTH

"You don't want to see me in a wetsuit." **"The florist made me do it."** "I think we're fine. But if they sue, I'm blaming you" – legal chat between editor and chief sub. **"Laughing is the new straight face" – discussing WIRED's radical decision to allow (some) smiling in our portrait shots.** "Wait – is that a gold-plated house?" **"Yeah! You can do it! Never give up!" – wired.co.uk staff pep-talk for eating a very large cake.**

BABY-RELATED FAREWELLS THIS MONTH

We say *adieu* for now to Liat Clark, deputy editor of wired.co.uk, who, by time of publication, should be the proud mother of a small human. Congratulations from all at WIRED. Meanwhile, product editor Jeremy White has become the first man in Condé Nast UK history to request – and receive – paternity leave. Never let it be said we at WIRED aren't pioneering new modes of working...

MEET THE MICRO:BIT-ERS

Photographer David Vintiner went to Scunthorpe to visit the Winterton Community Academy, where he captured its pupils working with the micro:bit. "The kids were quick to learn and so inventive – but what we loved most was when the micro:bit flashed up YOLO [you only live once] on its LED display. Surprisingly philosophical for a computer chip."

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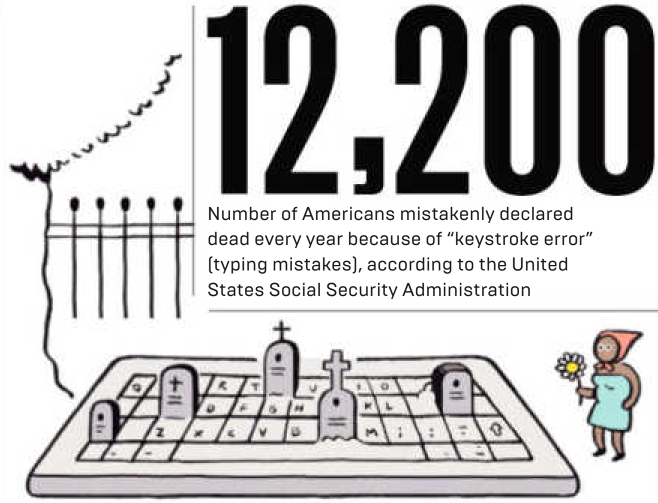
Never need to take off the case, because it enables pass-through charge & sync while connected to a computer. Made for the iPhone 6 Plus, this is mophie's thinnest juice pack yet, but don't let the design fool you It will deliver you up to 14.5 hours talk time and 7.5 hours web browsing additional.

Available in black, white and gold and fully Apple certified starting at £ 89.95.
Shop at Selfridges or visit **uk.mophie.com** or call **0808-134-9931**.

THE WIRED INDEX



12,200

Number of Americans mistakenly declared dead every year because of "keystroke error" (typing mistakes), according to the United States Social Security Administration

4 HOURS & 3 MINUTES

The record-breaking time it took Caitlyn Jenner to accrue one million followers on Twitter. The previous record holder was Barack Obama, at four hours and 52 minutes, just a month earlier

500,000

Number of duplicate customer records found in British Gas's system after the company transferred 11 million customers' data into a single repository, according to the company's director of insight and data Mike O'Donohue

270M

The number of monthly active users of *Wifi Skeleton Key*, a Chinese app that lets users connect to any Wi-Fi hotspot without knowing its password

£110

Booking alteration fee demanded by Ryanair from Manchester-based student Adam Armstrong after his plane ticket to Ibiza was mistakenly booked using the name Adam West

$1billion

The amount YouTube paid the music industry for 2005-2014, according to its content VP Tom Pickett

$82.6m

The pay package received in 2014 by Angela Ahrendts, Apple's senior vice-president of retail, according to the Bloomberg Pay Index. Although not in the top ten, It was the largest paid to a female executive in the US

£103

Amount Armstrong paid to change his name and buy a new passport

$2billion

Amount Spotify paid the music industry from 2008 to November 2014, according to CEO Daniel Ek

18,446,744,073,709,551,616

The number of planets that can be explored in Hello Games' space-travelling video game *No Man's Sky*. You'd need 584,942,417,355 years to visit them all

ILLUSTRATION: GIACOMO GAMBINERI. SOURCES: HSGAC.SENATE.GOV; GUINNESS WORLD RECORDS; IEONDEMAND.COM; TECHINASIA.COM; RYANAIR; PRESSROOM.MIDEM.COM; BLOOMBERG.COM; SPOTIFYARTISTS.COM; BLOG.EU.PLAYSTATION.COM

OCEAN

OCEAN LABS

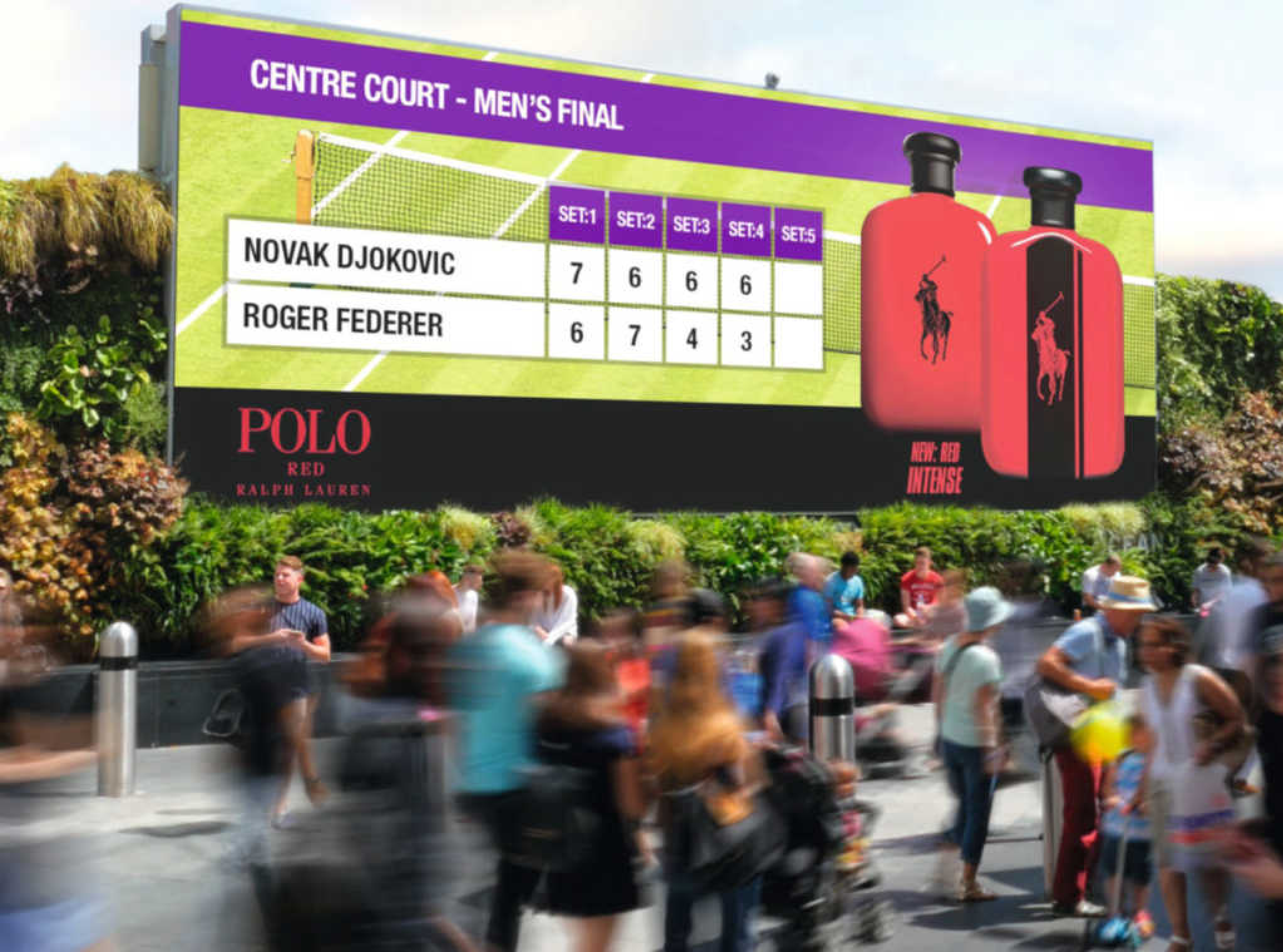
DATA AMPLIFIES DIGITAL OUT OF HOME ACTIVITY

Luxury fashion brand Ralph Lauren used innovative Digital Out of Home technology to promote its latest fragrance for men; Polo Red.

Ocean's Score:Board technology served live score updates to iconic screens across London as the drama unfolded at Wimbledon, with a version of the Polo Red TV ad running before and after matches.

The flexibility and impact of this technology allows brands to be broadcasters in their own right, amplifying their activity and delivering time relevant campaigns.

Find out more at
oceanoutdoor.com/polo



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